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Special Features of New Locomotives for the Atchison, Topeka & Santa Fe Ry.

Among a number of locomotives put in service recently by the Atchison, Topeka & Santa Fé Ry. (and built by the Baldwin Locomotive Works) are 32 four-cylinder balanced compound passenger engines of the 4:6:2 class, and 29 freight engines of the 2:8:2 class, which present some points of interest.

Tenders with Six-Wheel Trucks

Balanced-compound locomotives are used extensively on this road, and the engines have proved thoroughly satisfactory in handling heavy fast passenger trains under the exceptionally difficult conditions which exist on certain divisions. The 32 new engines of this class are practically identical with 28 which were put in service last year and were described in Engineering News of March 28 and Nov. 7, 1912, except that they have the unusual feature of being equipped with tenders carried on six-wheel trucks.

The engines have 73-in. driving wheels, and cylinders 17½x28 and 29x28 in. The boilers have radial-stay fireboxes, Schmidt superheaters (619 sq.ft.) and 3444 sq.ft. of heating surface, instead of the Jacobs-Shupert firebox, the Buck-Jacobs superheater (806 sq.ft.) and 3325 sq.ft. of heating surface. Oil fuel is used by 13 of the engines, 15 use bituminous coal, and four use Gallup lignite coal. The weight on driving wheels is 164,100 lb. and total weight of engine 271,700 lb., these weights being slightly greater and less respectively than in the earier engines. The reduction is in the weight over the trailing axle, which is 51,200 lb. in the new engines as compared with 60,620 lb. in the earlier engines.

The tenders carry 9000 gal. of water and 12 tons of coal, but are mounted on six-wheel trucks. This is said to be the first application of such tenders to engines of this class, although they have been used on some Mallet engines (Engineering News, May 4, 1911). They increase the weight to 185,700 lb. as compared with 171,500 lb. for tenders of the same capacity with four-wheel trucks, and they increase the total wheelbase of the engine and tender to 66 ft. 11¾ in. as compared with 56 ft. 1½ in. in the earlier engines. The average axle load, however, is reduced from 42,875 lb. on the earlier to 30,950 lb. on the new engines, which latter is moderate in comparison with the loads of many tenders of large capacity. The truck wheelbase is 8 ft. 4 in.

Each truck frame is of cast steel, in one piece, with pedestals of the same material bolted to it. The bolster is also of cast steel, and is suspended on heart-shaped links which are pinned to the transverse sections of the frame. These links are unsymmetrical, the outside upper pin in each being vertically above the lower pin. As a result, one side of the bolster is raised higher than the other when the truck is displaced on a curve, thus helping to maintain the stability of the tender and keeping a more even distribution of weight on the inner and outer rails. The springs are of the semielliptic pattern, directly over the boxes, and connected by cast-steel equalizers which support the truck frame. These trucks were designed by the Commonwealth Steel Co., in conjunction with the office of the mechanical engineer of the railway.

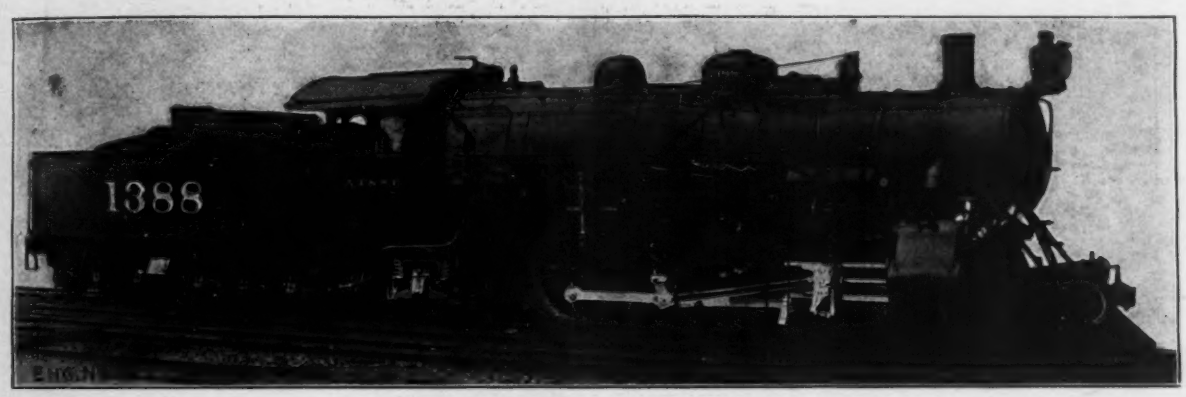

Fig. 1. Four-Cylinder Balanced-Compound 4:6:2 Passenger Locomotive with Twelve-Wheel Tender; Atchison, Topeka & Santa Fé Ry.
(Baldwin Locomotive Works, builders.)

2:8:2 Freight Engines

This type of engine has not previously been used on the A., T. & S. F. Ry., and the engines are intended for heavy freight service on divisions having moderate grades. They were designed with a weight limitation of 55,000 lb. per driving-axle, and the actual weight runs

close to this limit. The distribution is very even, the minimum and maximum axle weights being respectively 54,500 and 54,900 lb. The tractive force exerted is 50,700 lb., and the locomotives can traverse 16° curves.

Special attention was given to making the details interchangeable with those of locomotives previously built. This problem of standardizing locomotive details is specially difficult on such a road as this, which includes both level and mountain divisions, and requires a variety of locomotive types for its successful operation. This problem, however, is being successfully solved; and the new 2:8:2 locomotives illustrate in a striking manner how the work is being accomplished. The result will be a decrease in maintenance costs and in the amount of stock required for renewals, together with fewer engine failures and increased motive-power efficiency.

the 2:10:2 engines) have supplemental counterwe[illegible]s which are keyed to the main axle between the fra[illegible]s. This has proved a satisfactory method of counterwe[illegible]ing locomotives which have heavy reciprocating and [illegible]volving parts and comparatively small driving-wheel[illegible]

The arrangement of the rear frames and trailing t[illegible]k is materially different from that used in the 2:10:2 l[illegible]motives. In the latter design, the firebox extends f[illegible]ward over the rear drivers, and the trailing truck, wh[illegible]h carries 25,500 lb., is of the Rushton pattern, with in[illegible]e journals 7½x12 in. In the new 2:8:2 locomotives, t[illegible]e firebox is placed back of the driving wheels. The r[illegible]r truck is also of the Rushton pattern, but with outs[illegible]e journals 8x14 in., and it carries 40,700 lb. The tender[illegible]s are of the railway company's standard design, carrying 8500 gal. of water and 12 tons of coal. A coal pusher

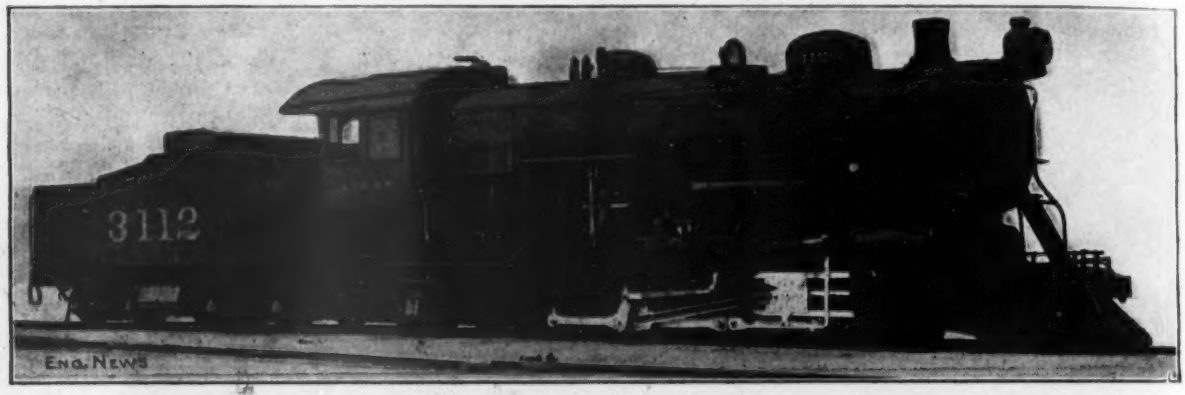

FIG. 2. HEAVY FREIGHT LOCOMOTIVE OF THE 2:8:2 CLASS; ATCHISON, TOPEKA & SANTA FÉ RY.
(Baldwin Locomotive Works, builders.)

This interchangeability of parts of the new 2:8:2 engines applies especially to those of the 2:10:2 class, which is used extensively on this road. The engines of both classes have the same piston stroke and driving-wheel diameter. Their driving-wheel centers, tires, boxes, axles, crankpins, piston valves, and frame cross-ties are interchangeable; as are also the valve-gear details, as far as possible. The boilers of the 2:8:2 class, although somewhat smaller than those of the other class, are generally similar in construction. The safety valves are mounted over a 16-in. manhole, back of the main dome. The openings for the dome manhole are in the third boiler ring, which has a welded longitudinal seam on the top center line. The joint is strengthened by a large inside liner, cut from a single piece of $\frac{11}{16}$-in. plate. The dome is of pressed steel, in one piece. The furnace equipment includes a brick-arch, and power-operated fire-door and grate shaker.

The cylinders are provided with vacuum relief valves, and also with drifting valves of the Sheedy pattern. The main frames extend forward under the cylinder saddle, in the form of single rails 5 in. wide and taper in depth from 12 in. at the front to 15 in. at the back. The steam distribution is controlled by 16-in. piston valves, which are driven by Walschaerts gear and are set with a lead of ¼ in. The valve-gear is controlled by the Ragonnet reverse mechanism (ENGINEERING NEWS, Nov. 7, 1912), which has been applied to all road engines recently built for this railway. These new 2:8:2 engines (like is provided. The dimensions of the new freight engines are given in the accompanying table:

FREIGHT LOCOMOTIVES OF THE 2:8:2 CLASS; A., T. & S. F. RY.

Driving wheels (8)	4 ft. 9 in.
Front truck wheels (2)	2 ft. 5½ in.
Rear truck wheels (2)	3 ft. 4 in.
Tender wheels (8)	2 ft. 10½ in.
Journals, driving axles	11x12 in.
Wheelbase	16 ft. 0 in.
Engine, total	34 ft. 1 in.
Engine and tender	66 ft. 0 in.
Weight in working order: on drivers	218,900 lb.
On front truck	24,500 lb.
On rear truck	40,700 lb.
Engine, total	284,100 lb.
Engine and tender	455,000 lb.
Cylinders (2)	25x32 in.
Valves, piston, diameter	16 in.
Reversing gear	Ragonnet (steam
Boiler (wagon-top) diameter	6 ft. 6½ in.
Barrel plates	7/16 in. and ½ in.
Working pressure	170 lb.
Fuel	Soft coal
Firebox (radial stay)	9 ft. x 6 ft. 6 in.
Depth, front and back	7 ft. 2 in. and 6 ft. 4 in.
Side, back and crown sheets	⅜ in.
Tube sheet	½ in.
Tubes, iron;	240, 2¼ in.; 36, 5½ in.
Length	20 ft.
Superheater	Schmidt
Heating surface, tubes	3849 sq.ft.
Firebox	237 sq.ft.
Arch tubes	25 sq.ft.
Total	4111 sq.ft.
Superheating surface	880 sq.ft.
Grate area	58.5 sq.ft.
Water in tender	8500 gal.
Coal in tender	12 tons

Self-Propelled Street Cars have been recommended for experimental service on the Edinburgh (Scotland) municipal tramways, by a deputation of the city Council after studying the operation of motor busses and cars in London, Morecambe and Paris. They favor the gasoline-electric self-contained type and report that high first cost is counterbalanced by saving in cost of tramway wires or conduits.

A Bonus System for the Purchase of Portland Cement

In the *Philippine Journal of Science* for April, 1913, W. C. Reibling, of the Division of General Inorganic and Physical Chemistry, Bureau of Science, of the Philippine Islands, presents a paper in which he advocates the adoption of a bonus system for the purchase of portland cement. Mr. Reibling's proposition is the result of an extended series of tests on portland cement as used in the Philippines and as bought under the government specifications in vogue there.* As a result of this investigation he has come to the conclusion that there should be a standard specification below which no cement should be accepted, but that cement which is far superior to the specification should be paid for in proportion to its superiority. The paper is a rather lengthy one, too lengthy for reproduction here, but we give below an abstract of Mr. Reibling's summary and a transcript of his suggested bonus system.

His argument in the article is as follows: A résumé of the operation of standard specifications for portland cement shows the need of improving contracting methods for the purchase of this material. At present there is little incentive to induce a manufacturer to grind and burn to the degree of perfection that modern improvements have made practicable. In order to secure the desired constancy and volume, strength, setting properties and sand-carrying capacity, the raw materials must be carefully selected and regulated, finely ground and very thoroughly mixed and hard burned, and the finished product must be of extreme finness and properly packed. None of these factors can be neglected.

Increased efficiency can be obtained only at a correspondingly greater expense to the manufacturer, and portland cement should be purchased on a basis of quality as well as quantity.

Desirable results can be obtained only by establishing a reasonable standard for the purchase and use of portland cement which will be fair to the manufacturer and take into consideration the work capable of being done as well as the quantity of cement used, and this standard must be applicable to a system which will induce and foster competition.

The Bonus System Proposed

In view of the foregoing it is suggested that portland cement be purchased as heretofore from the lowest bidder who guarantees to fulfill the requirement of specifications, and that the following provisions be made for bonuses to be awarded for superior quality:

1. No bonus will be awarded unless the cement passes all of the specified requirements including perfect soundness after the steaming test and unless the cement is reasonably uniform in quality and suitably packed.

2. A bonus of 10 centavos per barrel will be awarded if the specific gravity is consistently above 3.10 (or the loss by ignition not greater than 2%).

3. A bonus of 10 centavos per barrel will be awarded if the residue on the number 200 sieve is less than 15%, and that on the number 100 sieve less than 3%.

4. Provided the gravity is not less than 3.10 (or the loss by ignition not greater than 2%), a bonus of 10 centavos per barrel will be awarded if the 28-day, 1 : 3, standard Ottawa-sand briquettes show consistently an average tensile strength above 400 lb. per sq.in.†

The above would provide bonuses for superior mixing, grinding, and burning, and would permit the manufacturer to earn 30 centavos (15c. United States currency) per barrel in excess of the selling price. In Manila, 30 centavos is about 5.7% of the usual cost of portland cement and less than 1% of the cost of concrete. On the other hand, such a system properly enforced ought to secure at least 10% better concrete, eliminate the necessity of rejecting cement, and secure greater certainty in its use.

Owing to the varying influences of local conditions in different localities on the cost of manufacture, the values given in this proposed system are not arbitrary. However, the principles constitute the essential features, and they must remain fixed.

Good packing is insisted upon in order to prevent properly stored cement from serious deterioration. Perfect soundness (no warping, checking, cracking, or disintegrating after the hot test) is also essential, and it might be advisable, as recommended by H. J. Force, even to substitute the more severe autoclave test for steaming or boiling under ordinary pressure.

It is useless to insist upon soundness unless we also take into consideration the specific gravity (or the loss by ignition). We can season an underburned cement, or a cement made from poorly mixed or coarsely ground raw materials, until it passes the accelerated tests for soundness; not, however, without a corresponding reduction in the specific gravity and increase in the loss by ignition. Likewise, we cannot rely upon the specific gravity or loss by ignition without taking into consideration the soundness. A nonseasoned portland cement usually has a high specific gravity regardless of whether it is underburned or hardburned and regardless of the amount of free lime present. Therefore, a bonus is provided for perfect soundness in conjunction with a high specific gravity (or a low loss by ignition) for the purpose of securing a well burned product.

Another bonus is provided for superiority in strength in order to induce a careful selection and regulation of the raw materials. Ordinarily it would not be advisable to base a bonus on the strength developed in 28 days. If a cement contains more than a very small quantity of hardburned free lime, then no reliance can be placed on the results of the early tests for strength. However, well burned cements show little or no decrease in strength with age; and, since it is specified that no bonus will be awarded unless the cement is well burned; that is, unless it has a high gravity (or low volatile constituents) and is perfectly sound, no bonus would be granted except for superior permanent strength.

Under this system the manufacturer would be permitted to earn 30 centavos (15c. U. S. currency) per barrel in excess of the selling price, provided he supplies a well burned, finely ground product and a standard 1 : 3 Ottawa-sand mortar to show consistently an average reliable strength of over 400 lb. per sq.in. It would secure at least 10% greater concrete efficiency and practically eliminate the necessity of rejecting cement.

Mr. Reibling submitted this system to certain manufacturers in the Far East, and he says that they have expressed their willingness to coöperate. The agent of one company wrote to him as follows:

The advantages to be secured from such a system as suggested are of so pronounced a nature to both the purchaser and to the contractor that it is not necessary to enlarge on them. The manufacturers would have every inducement to produce cement above the minimum requirements set by the specifications, and the bonus would undoubtedly cover the extra cost incurred for special care in packing, burning and grinding. In the majority of cases, the manufacturer and his agent are very desirous to execute their contracts to the satisfaction of all parties, and where financial conditions permit, would prefer to supply material above the specifications in order to avoid any risk of loss through rejection and consequent dissatisfaction. The above expression of opinion has behind it the result of ten years' trading in cement and business here amounting to over 100,000 bbl. since the beginning of the year. We shall be glad if it is possible to handle cement for the Government on the bonus system mentioned above, and shall be pleased to let you have any information from the factory that may assist in the furthering of this system.

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*See "Engineering News," Oct. 3, 1908, p. 612; Feb. 13, 1913, p. 298.

†The above recommendations provide for the possibility of a well burned cement with a lower specific gravity than 3.10, if the low gravity is not due to an absorption of volatile constituent, but our [the Bureau of Science] experience does not include such a possibility.

Operation of the Mohawk River Bridge Dams

By D. A. Watt*

SYNOPSIS—Eight movable dams, consisting fundamentally of gates which are operated from bridge trusses, have been installed across the lower end of the Mohawk River, in its canalization for the New York State Barge Canal. These have been in use now long enough to permit the following notes as to the experience obtained on their operation.

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The Erie Division of the New York State Barge Canal connects with tidewater on the Hudson River at Troy, N. Y. From this point it follows the river north as far as Waterford, about 3 miles from the Troy dam, and then turns westerly into a small valley, apparently one of the outlets of the Mohawk River prior to the glacial epoch. Crossing the head of this valley it enters the Mohawk River just above Cohoes, and from there it follows this stream for about 90 miles, or as far as it can be utilized for canalization. About 34 miles of this distance is improved by four fixed dams (one with a Boulé movable crest), 10 miles by one needle dam, and 47 miles by eight bridge-and-gate dams, whose locations and dimensions are given in a following table. As these were the first movable dams of the bridge type to be built in this country, with the exception of the large bridge dam at St. Andrew's Rapids near Winnipeg, closed by Caméré curtains, the following notes regarding the experience obtained with their operation up to the present time may prove of interest.

Fig. 1. North Span, Fort Plain Dam, Mohawk River

(Showing the general details of construction and the method of handling the gates and uprights.)

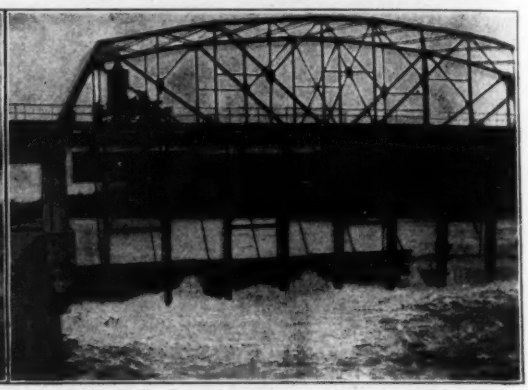

Fig. 2. Closing the Last Panels of the Lower Gates When Placing a Dam in Service, Cranesville Dam

(Head as shown, about 6½ ft. None of the upper gates have yet been lowered.)

Reasons for Adoption

The reasons for the adoption of bridge dams in preference to fixed dams or to movable dams of a more customary type were, briefly summarized, as follows: The central and upper portions of the Mohawk River have low banks which are overflowed each Spring, and occasionally in Summer also. On the south side of the valley there is the West Shore R.R., the present Erie Canal, and a highway; on the north side there is the main line of the New York Central R.R., a highway, and, for part of the distance, a trolley line. While the spring floods rarely cause much actual damage, ice jams are apt to occur every year at certain points, and may result in blocking traffic on the New York Central R.R. from one to three or four days, besides causing a destruction of part of their telegraph lines and flooding the highways and a portion of the trolley line. High water also comes occasionally which is not due to ice jams, as in October, 1903, and at the end of last March, and which causes a similar stoppage of travel. The high summer floods which occur every few years rarely affect traffic, but cause a loss of crops.

As claims are made against the State for every damage, real or imaginary, the building of fixed dams along this portion of the river would have given cause annually for many claims which would have been hard to disprove, as such dams would have changed entirely the regimen of the stream, and for all that could be foretold might have rendered the ice blockades still more serious. With the adoption of movable dams these claims could have no foundation; higher pool levels could be used, effecting a material saving in the amount of channel dredging; and the aggregate length of the dams necessary for passing the maximum flow would be only about one-half the corresponding estimated length required for fixed dams. This latter feature made the cost of the first construction slightly in favor of the movable dams.

The question of maneuvering was, however, a serious one. A least depth of 12 ft. in the channel would have to be maintained at all times while navigation was under way, while economy of construction and maintenance required high lifts and considerable depths on the sills in order to reduce to a minimum the number and the length of the dams, the fall being 91 ft. in 47 miles. These conditions would require an unfailing operation both in low water and during flood discharges, under high heads and in depths of water ranging from 16 to 20 ft. Moreover,

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TABLE OF BRIDGE DAMS ON THE MOHAWK RIVER, N. Y.

The first bridge dam is at Scotia, a short distance above Schenectady, N. Y.; the others follow in consecutive order as the river is ascended. All the dams are completed except the one at Scotia.
The depth on the sill is uniform at each dam, and the area below the elevation of the lockwall coping was made about equal to that of the original river bed below the same limit. All piers are 10 feet in thickness from the sills to a little above pool level, except at Tribes Hill, where the thickness is 12 feet.
All spans, with the exception of Dams 10 and 11, are arranged for future highway connections.

Number and location	Lift, Ft.	Depth on sill, Ft.	Number and length of spans. (Length is given at pool level between faces of masonry.)	Total net opening, Ft.	Foundations	Distance to dam next above, miles
Dam No. 4; Scotia	14.0	19.0	Two side spans of 150 ft. each; one center span of 210 ft.	510	Piers and cut-off wall on hardpan; all other portions on piles in sand and gravel	5.0
Dam No. 5; Rotterdam Junction	15.0	20.0	Same as above	510	All masonry is on piles, driven in sandy blue clay	6.0
Dam No. 6; Cranesville	15.0	20.0	Two side spans of 150 ft. each; one center span of 180 ft.	480	North span and pier, and abutment, on hardpan; the remainder on piles in sand and gravel	4.3
Dam No. 7; Amsterdam	12.0	20.0	Two side spans of 180 ft. each; one center span of 210 ft.	570	The dam is on compact gravel, no piles being used; the lock is on rock	4.4
Dam No. 8; Tribes Hill	11.0	16.0	Two spans of 240 ft. each	480	Lock, north span, and pier on rock; south span and abutment on piles in sandy blue clay	9.6
Dam No. 9; Yosts	8.0	18.0	Two spans of 180 ft. each	360	All masonry is on compact gravel, no piles being used.	7.8
Dam No. 10; Canajoharie	8.0	16.0	Two spans of 210 ft. each	420	The dam is on piles in sand and gravel; the lock is on rock	3.4
Dam No. 11; Ft. Plain	8.0	18.0	Two spans of 210 ft. each	420	All masonry is on rock	6.7

Total linear feet of dams, net opening, 3750; including piers, 3872.

on the existing State Canals it was customary, in conformity with time-honored precedent, to change the operating employees with every new Administration and sometimes oftener, and under such conditions it would be manifestly impracticable to secure or retain the services of men of experience with movable dams, as such men could be found only beyond the limits of New York State, and few, if any, were unemployed. It was therefore necessary, in order to avoid as far as possible the mishaps which are very liable to occur from errors of judgment in maneuvering these structures, to adopt a type which would take care automatically of small floods; whose successful operation would not depend too much upon judgment and experience; and in which the employees would not have to go too near the water.

An investigation of the experience obtained with the various classes of movable dams, begun in this country and completed in Europe, pointed to some modified form of bridge dam as being the most suitable. The chief objections to the type, viz., lack of headroom and high cost, did not affect seriously the case in question, as the flood range of the Mohawk rarely exceeds 20 or 25 ft. and at times when there would be a sufficient discharge for navigation in the open river the currents would be too strong for safe traffic. The cost of other types of movable dams suitable for the high heads and the considerable depths on the sills which were required for economy was found to be less than 10% below that of the proposed bridge dams, and their successful operation under the conditions described above was more than doubtful.*

Description of Dams

The final studies for the canalization of this portion of the river, as recommended to the State authorities for adoption and approved by them, comprised a series of eight bridge dams closed by cantilevered gates rolling upon movable girders. The latter are called "uprights." They are hinged to the bridge at the top and are supported at the bottom, when lowered, against cast-iron shoes in the masonry sill. The general features are shown in the accompanying views.† At all the dams the uprights were spaced 15 ft. apart, and the gates were made 29 ft. 8 in. in length, two tiers only being used. The various pieces are lowered and raised by pairs of chains operated by steam winches provided with chain wheels. (Fig. 7.) The largest gates of the lower tier (for a depth of 20 ft. in the sill) are 12 ft. 10 in. in height and 29 ft. 8 in. in length, with a weight of about 17,000 lb., and are maneuvered by 1½-in. chains. The corresponding gates of the upper tier are 7 ft. 4½ in. in height and 29 ft. 8 in. in length, with a weight of about 7000 lb., and are maneuvered by ¾-in. chains. In addition to these, two small drift gates (2 ft. 9 in. x 29 ft. 8 in.) are provided at each dam. The longest uprights are about 44½ ft. over all, and weight about 8500 lb., 1-in. chains being used for hoisting. All the main chains were made considerably stronger than required for ordinary maneuvers, on account of possible trouble from drift, etc.

By these arrangements the pieces to be handled were made few in number and of considerable strength; the discharge areas could be increased or lessened quickly and with comparatively simple maneuvers; and a spillway was secured which could be overflowed to a depth of several feet without harm.

The following table gives the principal features at each location.

Periods in Use

The operations of the dredging fleets of S. Pearson & Son and of the American Pipe & Construction Co. at various points along the river required certain of the dams to be put into service as soon as practicable. The Fort Plain dam was the first to be closed, and the pool was filled about Sept. 1, 1911, and maintained until Dec. 1. In the succeeding year (1912) this dam was again put into service, the pool being filled about the end of September and other dams were closed as needed. Thus the one at Cranesville was lowered about the middle of May; the one at Yosts about the 1st of May; the one at Rotterdam Junction about the 1st of September; and the one at Canajoharie about the 1st of November. They were all kept in operation until about the middle of December, when dredging was suspended for the season, and the dams were hoisted for the winter a few days later. At the present time six of the dams are in use.

Operation of Dams

Method of Closing—When preparing to put a dam into service, the uprights are lowered one pair at a time until their feet are near the shoe supports. Examination is then made with a pole worked from a skiff to see whether there is any gravel or other deposit against the face of the shoes. If any is found it is worked off and the pair of uprights is then lowered into place. Under its normal regimen the river carries very little silt or gravel, but the dredging operations have

*The actual cost of the construction per linear foot of the bridge dams, complete with the abutments and all sub and superstructures and protective work, but not including engineering, varied from about $400 for a rock foundation and moderate lift to about $530 for a pile foundation and high lift.

†An extended description of the dams with many drawings, was given in "Engineering News," Dec. 8, 1910, p. 611.

disturbed conditions temporarily, and at those dams just above which the dredges have been working parts of the sills were found to be covered with more or less gravel. Thus at Fort Plain the end of the south span, sheltered from the current by a portion of the coffer-dam which had not yet been removed, was found to be covered with sand and gravel to a maximum depth of about 4 ft. This was washed off by lowering several of the gates in the remainder of the span, creating a current sufficient to remove the deposit.

When all the uprights are bedded, the gates of the bottom tier are lowered part way until there is pressure enough upon them to hold the uprights firmly against the shoes. The first gate can be lowered until it rests upon the masonry, but as the opening becomes contracted and a head is created, a side current sets in around the end of the gate last in place, of a character similar to those seen in Fig. 3, but, of course, much less in swiftness. It is sufficient, however, to tend to swing sideways the feet of the adjacent pair of uprights if the load upon

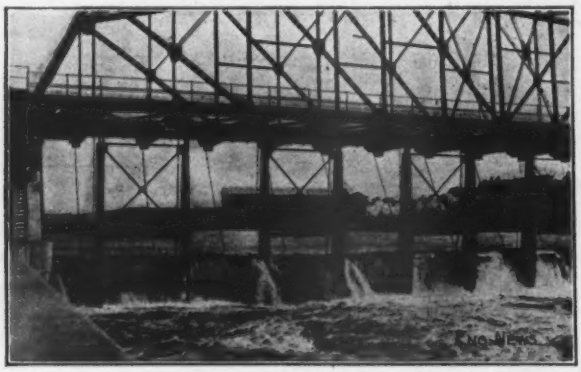

FIG. 3. THE FORT PLAIN DAM PASSING A SMALL FLOOD
(Head as shown, about 7 ft.)

them is small, and to push them off the shoes. If this occurs, the last gate is raised a few feet so as to reduce the current, the hoisting chains of the uprights are hauled up a little way, and the uprights swing back into line and are reseated. The remaining gates of the tier are then lowered a few feet at a time, working back and forth along the span until their final seating has been accomplished. By this method a pressure can be kept upon the uprights sufficient to prevent their being displaced by the side currents.

It has been found that an unloaded pair of uprights will stand a side pressure of about 2000 lb. before it is pushed off the shoes, equivalent to a head of 1 to 2 ft., depending on the discharge of the river. With a small flow the bottom tier of gates can be lowered in two moves, but with a large flow it takes three or four moves of 3 ft. to 4½ ft. each. Fig. 2 shows the final stage of this operation. The usual speed of hoisting or lowering is about 4 ft. per min. The gates can be held at any desired height by closing the chain locks, each of which consists of two hinged flaps of ½-in. steel plate, one on each side of the chain and with a clearance betwen them slightly greater than the thickness of the chain iron. They close against the flat side of the links, and the next link above rests upon them, thus supporting the load. The upper end of each chain is fastened to a U-bolt in the floor beam, and the slack is carried in a chain-box under the wooden floor. The planks over these boxes are framed as movable panels which are lifted off when operating.

The lowering of the bottom tier of gates is the most arduous portion of the work, as the chains were made of a size sufficient to provide an ample margin of safety, and in the highest dams are of 1½-in. iron. The winches were fitted with a light hinged A-frame at each end so as to allow blocks-and-tackle or differential hoists and spreaders to be used for handling the heaviest chains, but thus far all of them have been lifted on and off the chain-wheels by hand.

With the bottom tier in place the final closing of the dam is a simple matter, as the chains for a gate of the upper tier are of ⅝-in. to ¾-in. iron, a size which one man can lift and handle without difficulty. These gates are lowered as the discharge lessens, and when the low-water season arrives wooden joint covers are placed at their ends, closing the 4-in. gaps. The gaps between the lower gates are closed by ¼-in. flap plates, hinged to the skin plates, and swung over when the gates are lowered. Their ends are bent outwards to prevent catching on the adjacent gates during raising or lowering. The horizontal contact between the gates is formed by white-oak strips, bolted to the ironwork. These form a very tight joint, as shown by Fig. 4. Thus far no special means, such as using boiler ashes or fine gravel, have been taken to reduce the leakage, and even during the unusually low water of last summer the loss was so small that the water overflowed the crests to a depth of two or three inches, except when most of the discharge was being diverted into the feeders of the Erie Canal. This diversion was taking place at the time when some of the accompanying photographs were taken.

POOL REGULATION—Regulation of the pool has been carried on almost entirely by the upper tiers of gates, owing to the greater ease of handling the chains. The lower-pool depths on the sills at a low-water stage varies from 5 to 10 ft., as may be seen on reference to the table, but the effect upon the current a short distance below the dam appears to be the same whether the upper or the lower gates are used. However, when passing a flood through those dams which have high lifts the use of the lower gates avoids pouring a large volume of water directly upon the sill. For the same reason, when using the upper gates, it is preferable to distribute the flow, if considerable in amount, over a proportionate number of gates, instead of concentrating it by raising a few entirely. With small rises the two drift gates provided at each dam, measuring 2 ft. 9 in. in height and 29 ft. 8 in. in length, are used to pass a part of the discharge and the remainder is allowed to flow over the crest.

The wide spaces between the uprights are of much advantage in this respect, as they allow drift to pass without danger of clogging the openings and without requiring attention from the dam-tenders, and the large amount of free crest permits within moderate limits an automatic regulation of the pool. Thus during the operation of the Fort Plain dam in 1911 only a day watch was kept, any increase of level during the night being allowed to adjust itself over the crest. Late in October there came a rise of 7 or 8 ft. (measured in the open river), and on the afternoon of the 22d, shortly before the crest of the flood arrived, the pool level was drawn down to 1.2 ft. below

the tops of the gates, leaving enough of them raised to keep the expected flow within safe limits. When the crew returned the next morning the water was flowing 18 in. deep over the crest, and, as had been anticipated, was passing off without any complications having resulted. (Fig. 3.) By the afternoon the level was drawn down to about the normal elevation.

No footway between the uprights, such as is usually placed on bridge dams near the upper pool, was provided on the Mohawk structures, as it was considered preferable to keep the crest as unobstructed as possible, and experience thus far has approved this belief.

Method of Opening—The operation of opening a dam is the reverse of closing; the upper tier of gates is hoisted to the top of the uprights, and the gates of the lower tier are then raised. This is done by successive stages so as to prevent the side currents from pushing the feet of the uprights off the shoes, as before described.

Operating Force—During the operating season four men are employed at each dam, a head dam-tender who is required to have had experience with hoisting machinery, and three assistants, who are taught as far as practicable how to operate the winches. This arrangement provides one man for each 8-hour shift, and the fourth man, the head dam-tender, keeps a general watch and is required to be within call at all times. In case of emergency all hands can be summoned for assistance. Ordinary regulation is performed by one man, and he can, in case of need, raise a sufficient number of the upper gates (each of which covers an area of about 200 sq.ft.) without assistance to meet an ordinary summer flood. To provide for emergencies a pressure of steam of about 25 lb. is kept up on the winches, this being sufficient to raise an upper gate under a full head. Additional steam can be obtained very quickly, as the capacity of the boilers was made ample. Judging from the experience obtained thus far, it seems probable that each dam could be tended during the season of navigation by the employees, estimated at two men per shift, required for operating the adjoining lock, and without extra help except when full maneuvers were required in a short period of time.

While one man can raise the upper gates under ordinary conditions, two men are desirable when lowering them, and three are preferable for rapid work. The reason lies in the meshing of the chains with the chain-wheels. When hoisting, the strain of the load secures a proper seating of the links in the pockets of the wheels, and the only point to be watched is that the links should disengage after passing over. When only one man is operating, the winch is stopped at each half turn and the chains are examined and freed if necessary, and the hoisting is continued in this manner until the gate has reached the desired height. A full turn of the wheel will move an upper gate about 3½ ft., and a lower gate about 5 ft., the difference being due to the larger diameter needed for the links of the lower chains.

When lowering, the load has an opposite effect; the chains free themselves without trouble, but they have to be watched to see that the slack part does not climb upon the wheel. If this occurs, a light blow with a piece of wood usually seats the link without trouble, and if it has gone too far the winch is reversed until the link drops into its pocket. If only two men are available when lowering the one on the winch must keep watch over one chain and his companion must watch the other. For convenience it is, therefore, preferable to have a third man, thus providing one man close to each chain.

During the season of navigation, which commences in general after the Spring floods and closes as soon as the canal portions have become frozen over, usually early in December, floods of a height sufficient to require a maneuvering of all the parts of the dams, i.e., including a moving of the uprights, are of rare occurrence, and there will doubtless be seasons when the uprights can be allowed to remain down until the close of navigation. On the lower Seine, where the bridge dams are kept in operation winter and summer, full maneuvers are required on an average only twice a year, the uprights being allowed to stay in place until they begin to interfere undesirably with the passage of the water or of ice. At these dams the pairs of uprights are spaced 3.8 ft. c. to c., leaving clear spaces between of only about 2½ ft. These dimensions on the Mohawk dams are 15 ft. and about 14 ft. respectively. Injuries from ice, should the latter dams be exposed thereto, will probably be less than with the Seine dams (which have stood for nearly thirty years without serious damage) on account of the wider spacing of the parts. As may be remembered, the Poses dam, the furthest downstream of the Seine bridge dams, was rescued in 1894 from an ice-gorge which had blocked one span completely, the cakes having been drawn down by the flow under the partly raised curtains, finally choking from sill to pool the entire width betwen the two piers. By chopping out an opening about 7 or 8 ft. in width one set of uprights

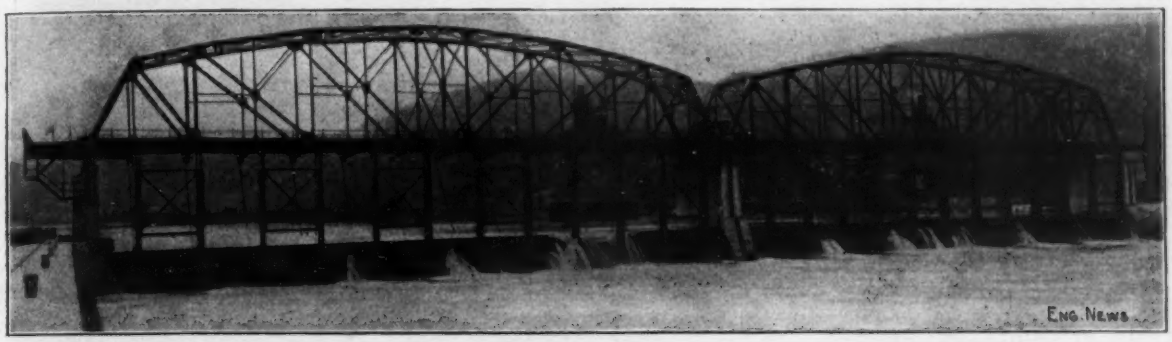

Fig. 4. General View of the Yosts Dam in the Low-Water Season
(Head as shown, about 10 ft.)

and curtains was hoisted out of the way, and the ice was gradually worked through.

Some temporary difficulty was experienced with ice at the Fort Plain dam about the middle of last December, just before it was put out of service for the winter. The temperature fell suddenly to near zero, and the river being very low the drift-ice massed against the gates to a depth of some 6 ft. and froze to them solidly. The intense cold seemed also to have frozen the gates together along the horizontal joints, and as all of them, including the small drift gates, were in place, there was no way of passing off the ice. After a good deal of difficulty, one gate was loosened and hauled up, and as the water surface became lower the ice broke loose by its own weight and was gradually worked through the gap. A rising temperature later in the day assisted in loosening the frozen joints, and the gates and uprights were then hauled up for the winter.

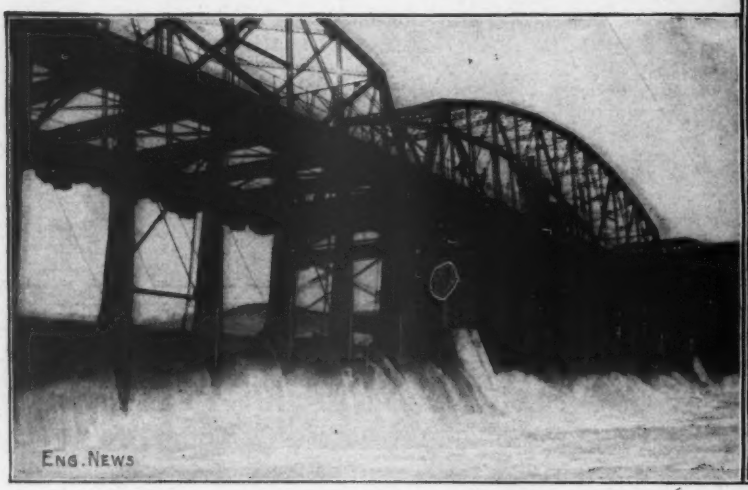

FIG. 5. GENERAL VIEW OF THE DAM AT ROTTERDAM JUNCTION DURING A MODERATE STAGE
(Head as shown, about 15½ ft.)

Maximum number of revolutions of crankshaft per ute, 270.
Boiler: Upright, 42x96 in., with 90 two-inch tubes; work pressure, 110 lb.
Main shaft, 6 in. diam., carrying 3 cast-steel chain wh (with 9, 10 and 12 pockets respectively, the largest ch having the smallest number) at each end, and conne to the crankshaft through five trains of cast-steel g with cut teeth. One of the intermediate shafts ha 9x12-in. winch head at each end.

FIG. 6. THE CRANESVILLE DAM HEAD OF 17 FT.

WINCHES—The operating winches are 16 in number, or two for each dam, and are duplicates in all respects except for the sizes of the pockets of the chain-wheels, the lower gate chains for the dams with the greatest depths of water being a little larger than those with lesser depths. The comparative advantages of gasoline, steam and electricity for the operation were carefully examined, and the verdict was in favor of steam as possessing the greatest reliability and simplicity, and being more widely known to the majority of engine-runners. An aditional advantage was that each winch would be a self-contained unit and independent of outside conditions. The desirability of such an arrangement was illustrated during the floods of last March, referred to further on, when the electric power lines were temporarily disabled, and the high water and drift sweeping over the banks would have carried away any pole lines connected with the dams.

The principal dimensions of the winches (Fig. 7) are as follows:

Gage of track, 4 ft.
Dimension of car platform, 6x12½ ft.
Diameter of car wheels, 1 ft. 8 in.
Cylinders: Two 5½x10 in., reversible link motion.
Hoisting capacity required, 50,000 lb. total load on the largest chain-wheels, hoisted at 6 ft. per min., or 44,000 lb. at 7½ ft. per min., with a steam pressure of 110 lb.

An ample margin of strength was provided throughout, and under test a load of 50,000 lb. was raised 6 ft. in 30 seconds with a loss of only 5 lb. of steam pressure. This test was made in cold weather, and before the boilers were covered. The speed used in maneuvering is about 4 ft. per sec.

No connections for hand operation were provided, as it was found that they would multiply the gearing, and that there would be in consequence a very large amount of friction to be overcome before any effective work could result. As each dam was to have two duplicate winches, the probability of an entire stoppage from breakdowns was believed to be doubtful enough to allow hand operation to be eliminated, especially as such operation could hardly be made efficient.

The winches are self-propelling, the driving shaft being connected to one pair of the wheels of the truck at the end away from the boiler. Water is carried in a tank attached to the side of the boiler, and coal in the upright box seen in Fig. 7. A water-storage tank is placed

at the end of one of the bridge spans, and is supplied from the upper pool by connecting to a steam siphon.

Effect of 1913 Flood

The storms of last March, which wrought so much havoc in the middle West, passed over the upper watershed of the Mohawk River and caused extremely high water. This occurred about ten days after the ice had passed out on the usual spring floods, and when the water was getting so low that dredging operations were being hindered.

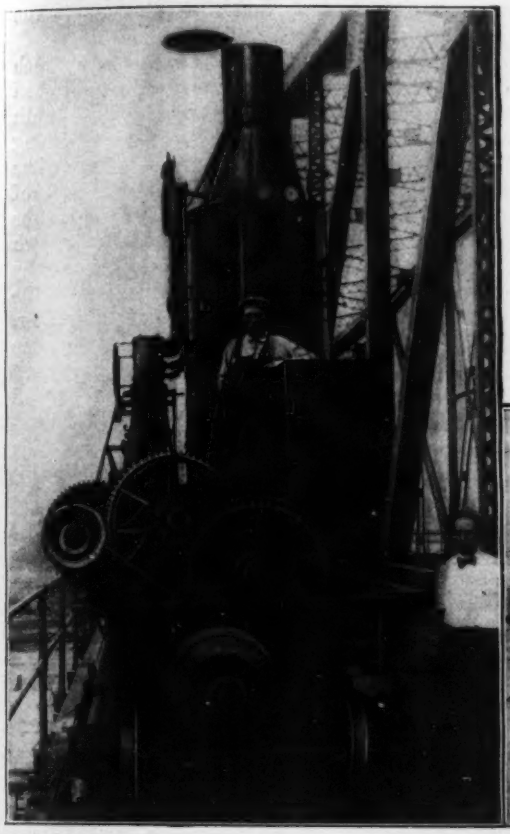

Fig. 7. General View of an Operating Winch

Fig. 8. Yosts Dam during the Flood of March, 1913, Showing the Effects of the Drift
(Taken after most of the lower gates had been pulled up.)

Dam No. 9, Yosts—Preparation was accordingly made for putting some of the dams in commission, and the one at Yosts (Fig. 4) was closed by Mar. 22, and the closing of the one at Fort Plain was begun on Monday, Mar. 24. During the latter operation, however, the river began to rise slowly, and on the next day, when about one-third of the uprights and gates had been placed, it was deemed best to suspend work until the water fell. Word was then sent to Yosts to raise all the upper gates, and this was accomplished shortly before night, when all the operating force went home. The head on the dam was then about 2½ ft., the upper pool being 1½ ft. above normal. There had been very little rain in the neighborhood, nor had any word been received of the flood which was already coming down the river, so that it appeared to be quite safe to leave the dam unattended until the morning. However, during the night the river rose very rapidly, and overtopping the banks picked up and carried off large quantities of drift of every description. Among it was a mass of timbers from a trestle bridge (some of them in bents 40 ft. in length) and part of the falsework of a highway bridge, all of which had been swept away by the ice and the last flood, and had been stranded high and dry some distance above the Yosts dam. Among the pieces was a pier bent built up of eight 14x14-in. timbers, 40 ft. in length and with the legs solidly braced together.

When the operating force hastened down early the next morning, the only means of access to the dam was along the tracks of the New York Central Railroad. The water had spread all across the valley, and was two feet deep over the lockwalls and still rising. Under the south span a mass of wreckage was tangled against the uprights and under their hoisting chains, and had collected until it had force enough to lift the uprights several inches and to push most of them sideways as well. (Their hinge-holes had been designed as slots so as to provide for lifting the feet over the shoes in case of jams from ice or drift.) The uprights had slid up the pins, but not quite far enough to "jump" the shoes, and apparently no damage had been done, although the two pairs next the pier, as shown by Fig. 8, had been pushed far enough sideways to clear the shoes, and only the hoisting chains prevented them from swinging free. The north span, however, had caught most of the trestle timbers and the falsework, besides much smaller drift. Every pair of uprights and all the lower gates had been lifted over the shoes, and the large timber bent described above had wedged its end between one pair near the pier, wrenching one of the members until the cotter of the hinge pin had sheared off, and the upright had swung sideways in the current, dragging its chain through the chain lock, but unable to fall on account of the bracing which still tied it to its fellow. Its condition is shown in Fig. 8. The chains of the two adjacent pairs had also dragged through the locks, but only part way, and the uprights were still hanging practically uninjured from the floor beams.

The situation was somewhat critical. Just behind the abutment was the main line of the New York Central

R.R., as shown by Fig. 4, and while the State grade had been heavily paved in view of possible overtopping, no protection had been placed by the railroad company on their adjacent embankment. The water was pouring 11 ft. deep over the lower gates, and was racing along the sides of the embankment with a depth of several feet, although the difference of level above and below the dam was only about one foot. The current was too swift to permit of landing at any of the ladders leading to the bridge, but with the river rising and the lower gates and the drift blocking both spans, it was imperative to clear the spillway, or the railroad bed might be cut out and the abutment be flanked.

Accordingly, the head dam-tender, James Breslin, pushed out into the river in a skiff from a point about 150 ft. above the dam, on the chance of being able to reach some of the ironwork before he was carried over the dam or under the drift. Steering for the hoisting chain of one of the uprights, he grasped it as the boat swept past and clambered up it and over the floor beam until he reached the floor of the bridge. The boat caught on the edge of the drift, and with the aid of a line

FIG. 9. YOSTS DAM DURING 1913 FLOOD

(Taken after the uprights of the north span had been allowed to swing free. Reprinted from "Engineering News," Apr. 24, 1913, p. 841.)

from the bridge was pulled back to the embankment, when Resident Engineer Hendricks and after him one assistant caught the chain from the boat and climbed up it and reached the floor safely. The other members of the force reached the bridge by the safer but less exciting method of a boatswain's chair and a line from the spool of the steam winch.

The entire force, augmented later in the day by other State employees, then set to work, first hoisting as high as possible such of the lower gates as could be freed from drift. This relieved the flow of water somewhat, although the lower halves of the gates when hoisted were still immersed, owing to the height of the flood (Fig. 8). During the day the river remained almost stationary, but at nightfall it began to rise again, and continued rising during Thursday until it was 6 ft. over the lockwalls and a foot over the railroad tracks. The drift began to come in increasing quantities, diving under the mass against the dam and threatening to close both spans entirely (the south span had not yet been opened up), and it was decided finally that it would be best to release the chains of the uprights of the north span and give the drift a chance of escaping underneath the gates. The remaining pin and chain of the damaged pair of uprights were accordingly released, and the uprights allowed to fall into the river. The pins of the chain locks of the remaining pairs were also driven out, thus releasing the chains and allowing the uprights to swing free in the current, as seen in Fig. 9. Two lower gates and one upper gate, which were hopelessly blocked by drift, were released similarly and alowed to fall in the river.

These maneuvers provided an opening through which some of the drift was freed, while other larger pieces had to be cut up and hoisted out. One panel of the south span was next cleared after much labor by chopping up the largest drift and hoisting it up to and over the floor by lines from the winch spools, and the pair of uprights with its gates was then pulled up under the bridge. This gave a 30-ft. clear opening through which enough of the remaining drift was worked, piece by piece, to allow the rest of the uprights and gates of the span to be hoisted and made secure under the floor. By Saturday, after three days of strenuous labor, the ironwork was practically clear.

The last large piece of drift which the flood carried against the dam was a New York Central R.R. baggage car, which escaped from an express train which slid into the river early on Sunday morning at a point about a mile above the dam, owing to erosion of the embankment. It came floating down the river, minus its trucks and accompanied by a flotilla of express packages and trunks, and lodged against the uprights. There it was promptly cut to pieces by the now experienced dam-tenders, and sent on down the river. The incident illustrated the views of a railway passenger who some time previously had been heard assuring an acquaintance that the object of the uprights was to intercept barges which might break loose from their tows and be carried away by the current.

When low water came again the lost pair of uprights and the three gates were rescued from the river, and an examination showed that all the injuries suffered by the dam were one pair of uprights in the south span bent slightly sideways, and two pairs in the north span (including the pair thrown in the river) similarly bent, together with a wrenching of a few minor pieces, as plates and angles. None of the uprights was bent in the downstream direction, nor was the sideways bending sufficient to prevent their being put into service again after straightening. The small amount of bending in the angle-bracing between the pairs was remarkable; apparently the two members of each pair had jumped the shoes at about the same moment. Bolts had been used to fasten this bracing to the uprights in case damage from drift might occur, so that the removal and straightening of bent pieces was an easy matter.

DAM NO. 11, FORT PLAIN—The dam at Fort Plain, which had been partly in operation, as mentioned above, was the only other one whose ironwork was exposed to the flood. About a third of it, near the center of the river, was in place. The highest water rose to about three feet over the lockwalls, but as the dam was apparently suffering no injury, and such drift as was striking the gates and uprights was passing on down the river without doing any harm, no attempt at hoisting was made. The current, however, was very swift, and the head created at the gates by the swirl of water around them

reached a maximum of 4½ ft. On the recession of the flood it was found that no damage of any kind had resulted.

OTHER STRUCTURES—With the exception of the bending of the ironwork at Yosts and the washing away of some roadway and other embankment near one of the fixed dams below Schenectady, no injury was suffered by the Barge Canal structures along the river. Other interests, however, were less fortunate. One contractor lost a cableway tower from undermining, together with a large amount of cement and other material; at Herkimer a highway bridge was washed away; at Amsterdam a highway abutment was undermined and caused the loss of one span of its bridge; and near Yosts, as before mentioned, an express train on the New York Central R.R. slid into the river. Several pieces of floating plant belonging to contractors broke loose, but were recovered before they had suffered much damage.

ENGINEERING DESIGN AND CONTROL

The field operation of the dams is supervised from the Barge Canal office at Fort Plain, some of the dams being connected therewith by telephone. This work has been in charge of E. D. Hendricks, Resident Engineer, with Lewis Bartlett, A. O. Hollenbeck and J. D. Williams as assistants. The writer is indebted to these gentlemen for certain of the information and the photographs contained in this article.

The general plan of canalization and the details of the dams were designed by the writer, with the exception of the bridges, which were designed by William R. Davis, Chief Bridge Designer. Mr. Davis also rendered valued assistance in detailing the shop drawings of the gates and other ironwork. The operating winches were built from composite designs made by the contractor (J. S. Mundy) and the State Engineer's Department, and much credit is due to the former for the excellence of the machines supplied.

The Standardization of Hose and Hydrant Connections

For more than forty years attempts have been made to standardize hose couplings of fire departments throughout the country. Various associations have formally approved the standards proposed, but to effect the actual changing of a city's equipment has been a very slow process.

At the Baltimore meeting of the American Society of Mechanical Engineers, Mr. F. M. Griswold, General Inspector of the Home Insurance Co., presented a comprehensive paper on this subject, giving specifications for the National Standard hose couplings and explanations of the methods of procedure for the conversion of couplings of various dimensions to interchange with the standard.

The first thorough work looking to the adoption of a national-standard hose coupling was done in 1891. A canvass was made of the standard couplings in use by all the important cities of the United States, and a standard was then recommended whose dimensions were such as to allow it to be used in conjunction with couplings already in use, whose dimensions approximated those of the Standard. About 70% of the couplings listed in the report were susceptible to such adaptation. This was an important step toward a solution to the coupling problem; but it was shelved and permitted to lie dormant until the great fire in Baltimore, thirteen years later, demonstrated the necessity of definite action.

Under this stimulus, the matter was again taken up in 1904 at a convention held in Chattanooga, Tenn. There the question arose whether to advise the adoption of a hose-coupling thread having the extreme of mechanical strength without reference to the preponderance of designs then in use, or to seek for the introduction of a threaded coupling which would most closely accord with the majority in use, and at the same time prove to be an intermediary of such capacity as to accommodate itself to interchange with a large proportion of couplings not exactly conforming to its dimensions.

The latter method of procedure was accepted as promising the best success, and as a standard coupling for 2½-in. hose, one was submitted which showed a diameter of $3\frac{1}{8}$-in. over male and thread, with 7½ threads to the inch, by the use of which it was practically demonstrated that couplings ranging in outside diameter from $3^{1}/_{32}$ in. to $3^{3}/_{64}$ in., with either 7, 7½ or 8 threads to the inch could be so modified as to couple up in service with this suggested standard. Thus over 70% of the 2½-in. couplings, known to be in use, were rendered conformable to the proposed standard at small expense as to time, money or labor.

It was deemed wise to formulate specifications covering 2½-, 3-, 3½- and 4½-in. hose couplings. The specific details relating to each of the standard sizes are shown in printed specifications which may be obtained upon request from the National Board of Fire Underwriters at 135 William St., New York City.

These specifications include full-sized working drawings showing the details of the various dimensions above noted, and, in addition, contain matter descriptive of the methods of procedure for converting non-standard couplings to interchange with the National Standard service. They also cover the matter of standard fire-hydrant fittings.

It may be said, in explanation, that 2½-in. hose is the size in most general use by public fire departments, and it is in this size of hose that the most marked diversity in character and dimensions of couplings is to be found. The 3-in. and the 3½-in. sizes are used mainly for high pressure or fire-boat service and are not in general use.

A Fire-Prevention Conference is being arranged by the Fire Prevention Commission of Philadelphia acting under the auspices of the Department of Public Safety. This Commission has been studying fire waste in this country so as to be able to advise the Department of Public Safety about the control of fire waste in that city and to organize the inspection of property for the aid of the fire-fighting forces. The commission states that it has become apparent that, while a great deal of actual knowledge is in existence about fire control, there has been no way of coördinating and distributing it and there has been no meeting ground where states and municipalities could consider such questions together and proceed along a uniform campaign to reduce fire waste and the national cost of insurance. This conference will be held in Philadelphia, Oct. 13 to 18, inclusive. Committees are being organized on the following subjects, to have charge of the presentation of papers and discussions; location, zones of danger, building construction, building codes, private protection, public protection, equipment, compulsory standards, occupancy, inspection, management and orderliness of premises, legislation, education, insurance, and organization of an American fire-prevention league.

Collapse of a Reinforced-Concrete Frame in a Building, Vancouver, B. C.

By A. P. Hueckel*

On June 13, 1913, a portion of the first floor and basement of a rooming house under construction at 252 Pender St., Vancouver, B. C., collapsed and caused the death of one workman and the injury of seven others who

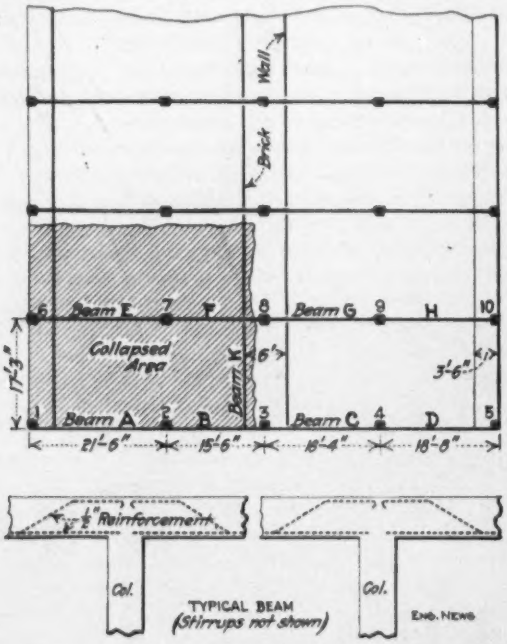

Fig. 1. Plan Layout of Building with Reinforced-Concrete Frame, Showing Collapsed Portion

Fig. 2. View of Point of Probable Primary Break

were at work on the structure. The upper three floors of the building were of straight mill construction, but the first and second floors were a reinforced-concrete frame supporting timber floors. The building was separated into two wings by an open area lined with hollow tile, as shown in the accompanying figures, and the collapsed portion was all on one side of this area and extended back only two bays.

The reinforced-concrete frame was made up of poorly hooped columns, carrying beams reinforced about as shown in Fig. 1. The primary failure evidently occurred in beam *A* or *B* in the rear of the building, and the entire upper portion was carried down as a result. The probable initial failure was at the junction of beam *B* with column 3 (Fig. 2), due to insufficient connection there.

The writer visited the building shortly after the accident and found the concrete porous and rough, indicating lack of sufficient tamping (Fig. 3). Apparently, however, this concrete withstood a unit stress, as given below, about three or four times the safe unit stress used in conservative designing. Judging from the testimony given at the coroner's inquest the placing of the stirrups and the bending of the truss rods were not in accordance with the plans but the arrangement of the steel at the supports appeared to be as designed. It is evident to competent designing engineers that the neatly hooked rods over the columns provided for no negative bending

Fig. 3. Where a Beam Pulled Out of a Column, Concrete Building Collapse, Vancouver, B. C.

*Resident Engineer, C. A. P. Turner, Vancouver, B. C.

moment. The following shows the size and main reinforcement of a number of spans.

Beam	Span	Size, width x depth	Reinforcement
A	20 ft. 9 in.	13½x20 in.	8 1-in. rounds
B	15 ft. 6 in.	13½x20 in.	8 ¾-in. rounds
C	18 ft. 4 in.	13½x20 in.	apparently 8 1-in. rounds
D	18 ft. 0 in.	13½x20 in.	apparently 8 1-in. rounds
F	15 ft. 6 in.	12x12 in.	6 ¾-in. rounds
K	16 ft. 6 in.	8x12 in.	apparently 6 ¾-in. rounds

At the time of failure, the equivalent uniform dead-load on beams *A*, *B*, *C* and *D*, was approximately 2650 lb. per lin.ft. or one-half of the final total dead-load. A low estimate of the live-load to be carried by these beams, is 2000 lb. per lin.ft.

From the information given the writer finds that the unit stresses due to the dead-load at the time of failure, in beam *A*, in the concrete and steel, was 2200 and 17,250 lb. per sq.in., respectively. The unit stresses for the entire dead-load would be about two times the above, while the stresses due to the total dead- and live-loads in concrete and steel would be 6070 and 47,500 lb. per sq.in., respectively. The measurements shown in the sketch may vary slightly from the exact dimensions but are as near as the writer could procure with a 6-ft. rule.

A coroner's inquest was held and a verdict rendered holding the contractor responsible on the ground of defective concrete and misplaced steel. The design is another example in which the architect secured the services of an engineer who failed to apply the primary principles of good design.

Figs. 2 and 3 show the appearance of parts of the building after its failure. The location of the views may be checked by the letters given on the halftones and on the drawing in Fig. 1.

Instructions for Foremen and Contractors on State Road Construction in Wisconsin*

GENERAL

Closing Roads—Roads under construction should be closed to travel whenever possible without too much inconvenience to the traveling public, and should be closed no matter how great the inconvenience when it is impossible or impracticable to construct the road if kept open. Every precaution should be taken to prevent damage to the public traveling a road which is kept open for travel, and it should be lightly fenced at each end and a sign posted somewhat as follows: "Danger! This Road is Under Construction. Travel at your own Risk."

Care on Work—If rates do not prohibit, it is best to insure all work with a casualty company to prevent any heavy loss from accidents to employees. But insured or not insured, every foreman should use every precaution which suggests itself in protecting dangerous parts of set up or moving machinery, and especially in the handling of dynamite.

Keep men well away when blasts are made, and never thaw dynamite except in a regular thawer or in a box inside of a larger box containing horse manure. Store stocks of dynamite well away from any camp or dwelling, and keep the place well posted and the container in a cool dry place, and locked.

Keep visitors away from dangerous parts of the work, and allow no one to ride on moving machinery except the engineer.

GRADING

Staking Out—If the road has been surveyed, before starting to move any earth, stake out the new center line for the distance expected to be constructed that year, according to the center measurements given on the grade sheet. If the stakes do not line up, or if the new center line does not strike the old grade to the best advantage, set the stakes where they should be and make corrections on the grade sheet accordingly. This precaution will sometimes save costly errors in grading. It is best to set the grade and slope stakes before grading is begun. Make the cuts and fills indicated on the plan and grade sheet, filling slightly in excess to allow for settlement.

If the cut or fill given for any station on the grade sheet does not make the grade line work out in accordance with the way it looks on the plan or is obviously wrong, fix that station so it looks right and reasonable and build accordingly. About 500 measurements and computations are necessary before the grade sheet of a mile of road is completed, and it need not be surprising if an occasional mistake is made.

If a cut is producing too much fill, raise the grade equally at every point in cut and on fill until it balances. If not enough dirt is produced, lower the line equally. Slip scrapers will be found to be the best tool to move dirt distances up to 75 ft., wheeled scrapers from 75 to 300 ft., wagons (preferably dump wagons) for distances over 300 ft.

In those cases where no surveys have been made stake out a center line for the road and cut the humps and fill the hollows until you believe a satisfactory job is secured. Then shape up to the required cross-section with road machine.

Cross-Sections and Slopes—In the case of roads to be surfaced, always do the rough grading described above to the dimensions of the standard cross-section, especially as far as the middle 18 ft. or so of the road is concerned. It makes the subgrading work much easier as no dirt has then to be moved except with the road machine to make the trench for stone.

It is best to do the grading and culvert work well in advance of the surfacing. That work is most successful on which the grading gang is out of the way of the gang laying stone or gravel.

For roads which are simply to be graded, use the standard cross-section for earth roads which fits the conditions you are encountering. The change in cross-section for different soil conditions is very important, and the finished cross-section for macadam and gravel roads should be the same as the earth-road sections for similar conditions.

Slopes in cuts must be hand trimmed to the slope required for the soil encountered. Easing up on work by leaving steep, untrimmed slopes is the poorest economy, and will not be allowed. Keep your ditch lines and edges of fills straight and true. Nothing will have more effect upon the looks of a job.

In the case of contracts for grading, the cross-section and slopes required must be specified in the body of the contract. It is well to remember on all work that on fills, about 2 ft. in width will usually be lost before the road finally settles, and to grade accordingly.

Guard Rail—Guard rail fence should be placed wherever the drop from the fill to a landing place is more than 4 ft., unless slopes of 1 on 3 or easier are used.

Ditches—In the final shaping up of the road with the road machine, be extremely careful not to dig in too deep in the ditches at any point so as to leave sumps to hold water, and if such places are made, be sure to fix them so that they will drain out, either by further trimming with the road machine or by hand-dug ditches. Nothing gives a worse impression than standing water in the ditches along a newly built road, and it is usually possible to avoid it if care is used in the final trimming up.

Where roads across marshes are built, cut the ditches as far away from the center line as is reasonably possible (never less than 16½ ft.), and clear and grub the entire distance between the ditches. In some cases water will have to stand in such ditches, but bottom elevations of ditches should be furnished by an engineer wherever the fall is small, but drainage is possible.

Tile Underdrain—Those places which should be tile underdrained are usually designated on the plans, but some of these spots may be missed by the surveying engineer. Tile should be used in all cases where the road is habitually springy or where running water is encountered in cuts. This holds true for roads only to be graded and drained as well as for surfaced roads. Directions for laying tile will be found in the specifications.

Culverts and Bridges—In general, new culverts will be built of concrete except where, on account of lack of concrete materials, poor bottom, or inability to close or partly close the road, they cannot be so built. In these cases, culverts made of a pure iron, cast iron, or "boiler steel" may be used. No wooden or dry rubble stone culverts will be allowed to remain on a surfaced state aid road in Wisconsin recommended for county maintenance.

If any concrete or wood floored steel bridges are on the road, surfacing material can be placed right up to the ends, but in the case of wooden bridges where the new span will

*Abstract of Bulletin 13, Wisconsin State Highway Commission, Madison, Wis.; A. R. Hirst, State Highway Engineer.

be over 6 ft., or where a steel bridge is to be replaced with a new one in a year or two, it is best to stop construction 25 ft. from each end, or further if the height of the new bridge will be much changed from that of the old.

In staking out a culvert, establish the center line of the road from the stakes at least 300 ft. on each side of it, lay out one-half the total length of the culvert on each side of the center stakes nearest the culvert, and stretch strings between these last stakes. These strings will give you the inside edge of your outside end-wall forms. Be careful to see that the end walls are parallel to the center line of the road. After lining up and setting up the end-wall forms, sight along these in both directions and see that they look right and are right before starting to place the concrete.

PREPARING FOR SURFACING

Width of Surface—Practically all surfaced roads will be built with a stone or gravel surface, 9 ft. wide, which experience in Wisconsin has proven to be ample for 90% of even the main traveled roads. The 9-ft. road has won its way until it is the standard width in practically every county in Wisconsin which has been building much modern stone or gravel road.

Laying out Subgrade or Trench—These remarks as to subgrade apply equally to all surfacings, whether stone, gravel or shale. Starting at the desired point, set two stakes opposite the reference stake, the distance between them being the width of the new road.

To do this, refer to the grade sheet, which gives the distance from the side stake (placed when the survey was made) to the center of the new road. Subtract from this distance one-half the desired width of road and put in a stake with inside edge at this distance from the reference stake. Opposite this stake place another with its inside edge distant the width of the road from the inside edge of the first one.

All stakes for subgrade should be made of ½-in. round iron about 24 in. long, and about 25 should be kept on each surfacing job.

Stake out 700 or 800 ft. at a time. Be sure that the stakes are in line, except at bends or on curves. Usually curves will have to be staked out by eye to get good results.

Plow Work—With a road plow cut as close to the inside edge of stakes as possible without disturbing them, turning the furrow toward the center of subgrade. Plow about 5 in. deep. One furrow on each side is generally sufficient. The plow should be equipped with shoe or wheel and coulter. If a rooter is used, three furrows on each side will usually be necessary. Make the first cut about 5 in. deep, as close to stakes as possible, the next 6 in. nearer the center of the road. Drop the shoe down so the rooter will run about 3 in. deep for the third cut, working 6 in. nearer center of subgrade than the previous furrow.

Grader Work—A light grader that can be handled with two horses is best. Use with the blade so set as to move the plowed ground from the center of trench or subgrade on to the bank outside of stake line. This work cannot be accomplished neatly with the grader alone, as some of the earth will roll back into the trench under the best of conditions. Make the trench deep enough. The depth at the sides should be at least the total loose depth of the two courses of material and more than this on sandy soils.

It is much easier to throw out excess material with the road grader after the surface is laid than it is to bring extra material up from the ditches or to haul it in by wagons during the finishing when the trench has not been made deep enough to hold the stone. Nothing is more essential than a good solid shoulder, and the time to get it is before material is placed in the trench. In clay soils after making the trench, plow drains through the shoulders every 50 ft. on both sides and every 25 ft. at low points between hills.

Hand Work—Straighten up the stakes and drive them firmly. Tie a chalk or binder-twine line to the stakes on each side so the line will draw on the inside faces of the stakes, drawing it tight. It is usually best to put in additional stakes at 50-ft. points so this line will not sag. These lines are to guide the laborer in trimming the shoulders so the edges will be straight and the grade uniform.

On a 9-ft. road, if these lines are set 7 in. above center of subgrade, they will be 1 ft. higher than the bottom of trench at the shoulder. On a 14-ft. road set lines 5 in. above center of subgrade. They will be 1 ft. higher than the bottom of trench at the shoulder.

The blade of an ordinary square-point dirt shovel is 1 ft. long, and can be used by the laborer to tell when trench is deep enough at sides by setting the blade of the shovel up to the line.

Clean out drainage trenches through shoulders, so that they really drain out from the trench. This will keep the trench from filling up in case it rains. It is well to widen the trench and road on the inside of curves.

Rolling Subgrade—After the subgrade has been properly shaped to the same crown (or, better, a slightly greater crown) than the finished road is to have, it should be rolled until hard, especially if recently filled. Any hollows that develop during the rolling should be filled. Roll enough, but stop when the top layer of earth starts to slip.

Wet spots in the subgrade should be shoveled out, filled with good earth or cinders and rolled. Don't leave sink holes with the expectation of filling them with crushed stone. They must be refilled with clean material if a good surface is to be gotten at that point.

SURFACING MACADAM

Spreading—The simplest and most satisfactory way to spread stone accurately to a definite depth is to know how many cubic yards are in a load, and figure how many feet of road it should cover to the depth required, and to spread it over that many feet and no more or no less. It is much the most convenient to have all loads hauled the same size, in which case the spreader can measure accurately just how to dump each load.

Daily Output of Stone Crusher—For macadam roads, much of the stone will be locally crushed, usually with portable jaw crushers. The screen should be in two sections 4 ft. long 30 in. in diam., the first section with perforations ½ in. in diam. and the sec nd with perforations 2 in. in diam. The bin should have three sections with a total capacity of not over 25 tons, and should be portable.

Arrangements for stone supply to the crusher should be such as to permit crushing not less than 75 cu.yd., and preferably 100 cu.yd. per working day. A daily output of less than 75 cu.yd. means an expensive job.

On roads of crushed stone or on any road where a roller is at work all the time, the crusher and roller must work to capacity if the road is to be built cheaply. On these roads at least 75 cu.yd. of surfacing material should be placed each day, and if possible even more should be placed, up to 100 cu.yd.

When a one-course gravel road is built and the roller finishes it later, speed is not so essential, but on every road there is a certain fixed job cost and daily cost which is the same whether much or little material is placed daily. The most economical road is always the one built in the least working days. Work gangs of such size that they can produce a good output each day.

First Course—(No. 1 Stone usually 2 to 3½ in. in size, usually spread to a loose depth of 5 in. never more than 6 in. and seldom less than 4 in.)

The first course of stone or gravel is dumped on the subgrade and spread to the required thickness with rakes and shovels; after which it is to be rolled until it is packed firm and hard and there is no movement under foot as you walk on it.

On very sandy soils, to keep the sand from working up through the stone, place a fair covering of clay, marsh hay, hay, straw, or weeds (good in the order named) before placing any stone.

Shoulder trenches should be filled with the No. 1 stone so as to make blind drains. Cover this with sods, grass side down, or with hay or straw to keep dirt from clogging the water course.

Care should be used in rolling the first course to keep the roller in the trench and not to overlap the stone and crush the shoulders. Roll from outer edge toward center.

Clay or screenings are seldom necessary on the first course.

Place about 200 ft. of first-course stone before starting to lay No. 2. No. 1 bin does not usually hold this much, but No. 2 stone can be put in the bottom course until the first course is laid 200 ft. ahead, provided the two sizes are kept in separate strips, laying say the first 125 ft. of No. 1 and then starting with No. 2. Some prefer to pile the No. 2 until the No. 1 is far enough ahead and use it when the end of the work is reached.

It takes a good man to make a good spreader. Much of the looks of the road depends upon his work and much of the money available can be wasted by a careless workman who doesn't spread to the depth required. Check the loose depth of the stone often and see that he is spreading each load to the proper distance.

Harrowing—Although not much used in Wisconsin, many highway engineers claim that a good stout spike-toothed harrow is a necessity in properly compacting stone and gravel, and that a large part of the rolling of the two first courses can be saved by thorough harrowing after spreading.

Second Course—(No. 2 Stone, usually ½ to 2 in. in size; usually spread to a loose depth of 4 in., never more than 5 in., seldom less than 3 in.)

The second course of stone is hauled on top of the first and spread evenly to the depth called for. This course is rolled commencing on each outer edge with the rear wheel half on the stone and half on the shoulders and rolling toward the center.

The roller should be run over this course a number of times until the stone or gravel is brought to shape and fairly well compacted before screenings or dust is applied. All low places that have shown up should be filled with No. 2 stone and high spots raked down so that the surface presents a smooth even appearance.

Third Course or Screenings—(No. 3 Stone, usually from dust to ½ in. in size. Not necessary to pit run gravel or shale roads.)

Screenings may be hauled at any time after subgrade has been finished. Dump in piles with inner edge about 2 ft. from edge of trench or subgrade. Never dump screenings on the second course. If a cubic yard is dumped in one place, the piles should be about 30 ft. apart for a 9-ft. road, or about 20 ft. apart for a 14-ft. road. A cubic yard of screenings under ordinary conditions will cover about 275 sq.ft. of surface.

Use a square-point dirt shovel to apply screenings. Put them on very thinly with a quick sweeping motion, working from one end of the road toward the other. Keep roller running constantly while putting on the screenings. Repeat this process until all voids between stones are filled. Roll until stone stops moving and the surface is hard, and all second-course stone slightly covered with screenings.

It is necessary to bind quartzite or granite with limestone screenings or clay. If clay is used, apply it dry a little at a time, and after the voids are well filled and the road is rolled, cover the surface with screenings, preferably with the dust screened out.

Don't use too many screenings—just enough to nicely cover the road at all stages is just right. Too many screenings simply allow the road to rut more easily.

Flushing—With the stone covered with screenings the road is ready for water. On clay soils trim down shoulders with road machine before applying water, to prevent too much mud at sides. Don't try to finish over 400 ft. of road at one time. It will dry out before you get it soaked. It is customary to finish up each night of every other night the road ready for finishing.

If screenings stick to tires, scrape them or keep them well wet or both. Sprinkle road until screenings are thoroughly soaked and tires run clean. When road is wet enough, follow sprinkler with roller. If screenings pick up on roller wheels, stop rolling and apply more water. Keep roller as close to sprinkler as possible.

If bare spots or holes appear, put on enough dust to cover them. Sprinkle and roll until water is continually carried along in front of the roller wheels, at every point of the road being flushed. The road is then finished.

Pit-run gravel roads are flushed in about the same way, but must be very wet when rolled or quite dry. A rainy day is the best time to finish a road. Never have more than 1000 ft. of unfinished road on your hands. Keep the work compact and finish as you go.

Trimming Up—After the road has dried sufficiently, use a road machine to smooth off the shoulders to proper slopes. Trim shoulders so water can get from center of road to ditches at every foot of the road's length. Remove all surplus material. Roll shoulders as far out as is safe to take roller. The road is then finished and can be thrown open to travel. Whenever the ground permits, it is a good plan to smooth off and widen one or both of the ditches so as to permit teams to use them as a dirt road in dry weather and as snow roads.

OTHER SURFACES

Gravel—Gravel roads built of gravel just as it occurs in the pit can be built in one course and fair results secured if no roller is available to roll it until after all material is placed, but it makes a much better road if the gravel is laid in two courses of 5 or 6 in. each loose.

If no roller or traction engine is available for the first course, make the trench and commence to lay and spread gravel commencing at the end from which the gravel is hauled, hauling all gravel for the road over the first course. If this makes hard hauling, apply clay until the gravel packs and keeps the ruts raked full.

After hauling all the first course, laying second course can commence and the top course rolled when a roller is available. No stone larger than 4-in. should be allowed in the bottom course, and none larger than 2½-in. in the top course. Always rake the larger stone to the bottom of the course being placed. Rake thoroughly.

The foregoing is not the advised procedure. It is preferable to have pit-run gravel roads built just as stone roads are built except that no screenings or third course is required. Crushed gravel should be laid in three courses in exactly the same manner as is crushed stone.

No gravel should be used that does not start to pack as soon as travel gets on it. Screening out sand or excess clay, or adding clay and harrowing it in will often work wonders with a gravel that does not pack well.

Shale—In a few counties shale roads are being built. Shale should be laid in a trench and in two thoroughly rolled courses to get the best results. A slight covering of clayey gravel will produce a much better wearing surface than the shale alone.

REMINDERS

Have all loads hauled of the same size. It helps to make spreading easy.

Keep traffic off the road while it is being built. A road can't be finished with teams constantly passing over the stone.

For many reasons, it is usually best to commence to build a road at the point farthest from rock or gravel supply, although if built the other way, the new road can be used as finished, which cuts down hauling cost, especially over sand.

No good stone or gravel road was ever built without a good subgrade to start from.

Don't lay stone in the mud; wait until road dries out.

Don't roll first course of stone too much. If dirt comes up so it shows, stop rolling.

Don't be afraid to roll the second course after you commence to apply screenings. The more it is rolled the better the road will be.

If the stone crawls ahead of roller, roll very slowly. In general, it is best not to run roller too fast.

Put screenings on evenly and a thin layer at a time—the roller will work them into the spaces between the stones.

The foreman who makes a reputation as a road builder is the one who has the capacity of taking care of men and tools, who knows what good work looks like and does it, and who is content with no work that he does unless he has done his best.

⁂

An Anglo-American Exhibition is to be held in London, England, from May to October, 1914, occupying the 150 acres of grounds and buildings at Shepherd's Bush. Its purpose is to celebrate the centenary of peace between the two nations (since the Treaty of Ghent in 1814) and to illustrate the developments in science, industry and art. A number of American and British engineers, railway officers and manufacturers, as well as public men, are supporting the enterprise. In regard to engineering and industrial work it is proposed to illustrate in various ways, the advancement in navigation, electricity, railways and roads, bridges, water supply and municipal work, the Panama canal, electric storage and transmission of power, machine tools and agricultural machinery, labor-saving devices, machinery, and mining and chemical engineering. A deputation of British representatives has visited this country recently, and the American Society in London is acting as the local American committee.

Increasing Production of Asphalt from Petroleum—Within the last few years the asphalt trade has been dominated to a steadily increasing extent by asphalt obtained by boiling down the heavy petroleum found in California and in the region of the Gulf of Mexico to a semisolid material, which has found wide use for roofing purposes and as a binder in modern road construction. A total of 333,213 short tons of this oil asphalt was made in 1912 and had a value at the points of production of $3,534,077. This is a gain of 33.7% over 1911, and is nearly three times as much as the output of all other kinds of asphalt taken together, as shown in the annual report by David T. Day, of the United States Geological Survey.

Asphaltic oils differ very widely in the proportion of asphalt contained, ranging from oils having no asphalt to very viscous oils which are suitable for road material with practically no refining. Such natural liquid asphalt is known in many localities, especially near Lander, Wyo. It has not yet come into popular use, as asphaltic residues of exactly the required consistency may be obtained more cheaply by boiling down the thinner asphaltic oils characteristic of many regions in Texas, California and Mexico.

The proportion of asphalt contained in the asphaltic oils of California, Texas, and Oklahoma varies within wide limits. The oils of the Coalinga district, California, vary from 1.89 to 57.42%. In the Kern River field there is a variation between 16.2 and 38.7%. In the Sunset-Midway-McKittrick region the variation ranges from 11 to 51%, in the Los Angeles field from 13.3 to 42.2%, and in the Santa Maria field from 12 to 42%. In Texas and Louisiana the asphaltic oils, which are limited practically to the region of the Gulf coast, show variations from no asphalt to a maximum of 20%.

Test of Pressure of Wet Concrete

By E. B. Germain*

The Aberthaw Construction Co., of Boston, Mass., has recently made test of the pressure of wet concrete to determine, if possible, the proper figures to be used in the design of forms. The test was made on small-area columns where a high head could be produced in a short time and is, therefore, applicable mainly to that condition of concrete laying, but it is of considerable value for general form design, particularly in showing that the quite heavy forms used by the company are more than justified.

The apparatus used consisted of an ordinary hot-water bag filled with water, a test tube, containing mercury inside the bag and a hollow glass column running from below the surface of the mercury in the tube through a rubber stopper in the neck of the hot-water bottle, and then bent back so as to come outside the form where it was again bent up (Fig. 1). Six of these bags were placed in each column (Fig. 2) and the mercury levels read on each after the column was filled.

Fig. 1. Hot-Water Bag and Mercury Tube Used in Test

The theory of the apparatus is very simple. The green concrete presses directly against the surface of the hot-water bag. The bag being filled with water, the reaction comes on the water and is equal to the concrete pressure. The water in turn exerts its pressure on the surface of the mercury in the test tube, forcing the mercury to rise in the small bore-glass column. The difference in levels of the mercury in the test tube and in the column gives the pressure in inches of mercury, which is readily changed to pounds per square inch. The pressures be read from a fluid head, the area of the bag exposed d not enter into the case.

The method of getting the level of the mercury in t test tube was to fill the tube to within 1 in. of the to put it in the bag, feel for the top and then measure dow 1 in. This level drops as the level in the column go up, the amount being determined by forcing the mercu up a foot in the column and measuring the depression the level in the test tube. From this amount a corre tion was made to fit each case.

The test was made on two columns 20 in. square, eac being about 20 ft. high. These columns were reinforced as shown in Fig. 2, which also shows at the left the inside of the testing face of the form with the testing apparatus in place. The test was in no sense a laboratory test; the columns were in a building being erected by the Aberthaw Construction Co., for the Boston Woven Hose & Rubber Co., at Cambridge, Mass.

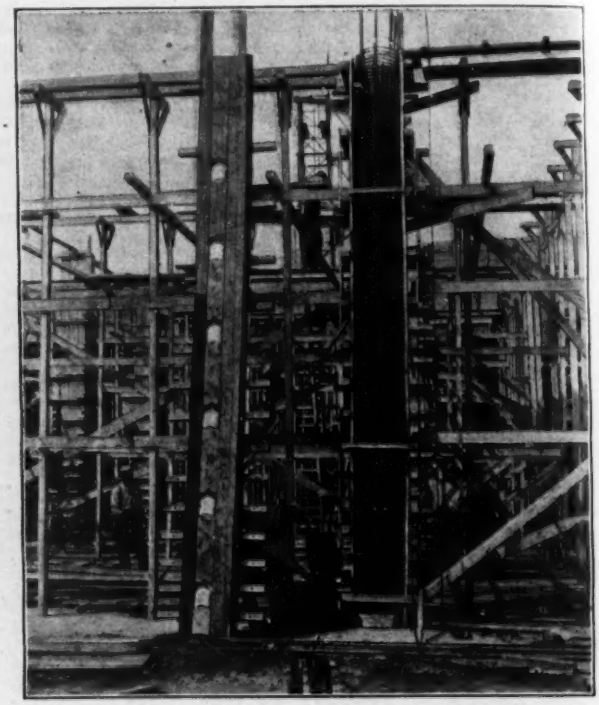

Fig. 2. Column to Be Tested, with Pressure Gages at Left

The first column tried was poured entirely in nine minutes by means of dump cars; the mixture being 1 part cement to 1½ parts sand to 3 parts of crushed stone. The stone used was 1 in. crusher run. The mixture was fairly wet, but no effort was made to get anything but the natural working condition. The second column happened to be one carrying a water tank, and so the mixture was quite rich, being 1 part cement to 1 part sand to 1 part of crushed stone. This column was poured entirely in 14 min. Stone and relative amount of water was about the same as in the first test.

The highest point of the mercury column was read in each case and the results obtained are shown in the accompanying table, where the pressure is obtained by multiplying the mercury head by the proper constant; the

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TABLE SHOWING PRESSURES IN CONCRETE COLUMNS DURING CONCRETE PLACING

Description of concrete	Column	Head (ft.)	Pressure (lb. per sq.ft.)	Hydraulic equivalent (lb. per cu.ft.)
Time of pouring—9 min. Mixture—1 : 1½ : 3. Stone—1-in. run-of-crusher. Wgt. of mixture, 152 lb. per cu.ft.	No. 1	3.08	460	149
		6.08	900	148
		9.08	1330	146
		12.08	1710	142
		15.08	2110	140
		18.08	Tube broke	
Time of pouring—14 min. Mixture—1 : 1 : 1. Stone—1-in. run-of-crusher. Wgt. of mixture—149 lb. per cu.ft.	No. 2	2.75	407	148
		5.75	840	146
		8.75	1280	146
		11.75	1700	145
		14.75	2080	141
		17.75	2450	138

"hydraulic equivalent" is the quotient of pressure by head.

These results checked each other quite closely. It is seen that the green concrete exerts a pressure nearly equal to that of a perfect fluid, and this in spite of the type of reinforcing (pitch of spirals 1½ in.) used on these columns.

The pressures in the lower part of the columns do not show quite full liquid pressure, due to the fact that the first concrete put in begins to set before the last concrete is poured.

Sprinkling and Oiling Streets, St. Paul, Minn.; Organization, Methods, Cost, and Method of Assessing Cost*

The sprinkling and oiling of streets in St. Paul, Minn., is under the jurisdiction of the Commissioner of Public Works. The sprinkling organization is under the direct charge of the Office Engineer and consists of a chief inspector, 9 district inspectors, 90 teamsters, 2 wagon repair men, 4 standpipe repair men, a chief record clerk and 2 assessment clerks.

The chief inspector devotes his whole time to looking after the field organization engaged in water sprinkling—namely, the district inspectors, teamsters and repair men. He also makes reports on the desirability of increasing or decreasing the sprinkling on certain streets and the moving of standpipes, investigates complaints regarding the service or efficiency of the men, and sees to it that the district inspectors perform their duties.

The district inspectors are paid $75 a month for 8 months and the teamsters $100 a month for the sprinkling season, which usually opens early in April and closes about Nov. 15. The teamsters work every day, including Sundays; in fact, excepting rainy days, they have but two days off during the season, July 4 and Labor Day. When wet weather makes sprinkling unnecessary, the teams are used by the Superintendent of Streets on other work.

The sprinkling and oiling of streets is ordered by the Common Council. The question of the number of times a day a street should be sprinkled and the streets to be oiled is left to the judgment of the Commissioner. In general, all macadam streets are oiled once or twice a year, and paved business streets are sprinkled four times a day.

SPRINKLING DISTRICTS—The sprinkling area of the city is divided into 9 districts, with from 8 to 12 teams to each district, under a district inspector (the boundaries of these districts do not conform to ward boundaries).

MAPS OF SPRINKLER ROUTES—For the streets to be sprinkled team routes are made up for each team so as to give each a full day's work, based on the number of trips to be made, grades, location of water hydrants, etc. To facilitate routing, the sprinkled area of the city is mapped on a scale of 600 ft. to 1 in. on sheets of uniform size, 8½x13½ in. These maps show blocks, names of streets, distance from center to center of streets, and location of standpipes.

Preliminary routings are made by using blueprints of these maps. The routings are then checked on the ground by an inspector. The teamster follows the designated route and a record is kept of the time and distance required to empty the tank, idle travel after the tank is emptied in getting to the next hydrant, etc. Work travel is plotted on the blueprint in full black lines, and idle travel, or back tracking, in dotted lines. The route is revised, if necessary, to reduce the idle travel to a minimum. Idle travel will average about 20% of the total travel.

EQUIPMENT—The water for sprinkling is taken from hydrants erected especially for sprinkling purposes, and is furnished free of charge by the municipal water-works. There are 480 of these hydrants. They are made of 2-in. galvanized-iron pipe with cast-iron casings, and cost complete about $58 apiece. They are a source of annoyance, however, as property owners object to them. They are located as far as possible at alley entrances on side streets.

The city working equipment consists of two 500-gal., fourteen 600-gal., twenty-one 700-gal. and sixty 750-gal. tank wagons; also of three oilers of 600-gal. capacity each, and two sanding wagons of 1¼ cu.yd. capacity each.

During the year 1912, six new water-sprinkling wagons of 750-gal. capacity were purchased. These cost $232.50 each. Also four new wood tanks of 750-gal. capacity each were bought to replace wornout tanks; these cost $57.50 each. One new 600-gal. oil-sprinkling wagon was purchased at a cost of $550. All the above equipment was bought under contract after advertising for bids.

Ninety water-tank wagons were in continuous use, leaving 11 in reserve. The total number of miles of streets sprinkled and oiled in 1912 was 269. Of these, 13½ miles of macadam streets were oiled once and 10½ miles were oiled twice.

The oiling equipment consists of four 10,000-gal. storage tanks near the tracks of the Northern Pacific Ry. The oil is heated from a small steam plant by means of pipe coils in the tanks, and is delivered to the oil wagons by adjustable spouts. A second combined oiling and calcium-chloride plant is now being constructed in the downtown district at Second and Cedar Streets, comprising three 10,000-gal. tanks located on the top of a bluff 85 ft. above the railroad tracks, to which the oil will be pumped from the cars through a 3½-in. pipe by an electrically driven pump having a capacity of 50 gal. per min.

METHOD OF APPLYING OIL—In oiling the streets, the macadam, if good, is first swept clean and then oiled with a 40% asphaltic oil, heated before leaving the storage tanks.

The oiling wagon is immediately followed by a sanding wagon, which sprinkles a thin coating of clean sand over the fresh oil. One side of the street only is oiled at a time. This permits traffic to use the other half while the oil is fresh and until it soaks into the macadam, and is taken up by the sand. One or two days' time is required

*Based on the 1912 Annual Report of the Commissioner of Public Works, St. Paul, Minn.

for this and then the other side of the street is oiled and sanded.

When the macadam is poor and getting worn out, no sweeping is done. The regular spring repair work is first done; the holes are filled and the surface rolled. The oil is then spread without sanding. Sanding is not necessary, as the oil is taken up by the fine material on the macadam. Such streets should not be opened to traffic for about three days.

Different weights of oil have been used, namely: 20%, 40% and 60% asphaltic oil. The 20% oil is used without heating or sanding afterwards. The 60% oil requires more heating, more oil and a heavier layer of sand, but does not give as good results. It does not bind with the old road surface and is inclined to slough off in large flakes. The 40% oil seems to be the happy medium, for while the 20% oil is easier to handle, it is too light for the traffic and wears out too quickly. The time between oilings is determined wholly by the conditions brought about by traffic and weather.

The oil distributors spray a width of 5 ft. 6 in., or it takes 5 trips to cover a 28-ft. driveway. The sand wagons spread 8 ft., or two trips of a sand wagon will cover three trips of the oil-spreader.

Sprinkling with Calcium Chloride—Calcium chloride is used on the downtown paved strets in the fall and spring when sprinkling is necessary and water would freeze. From ⅜ to ⅞ lb. is used per gal. of water, depending upon the temperature. The regular water sprinklers are used to distribute it. The water is heated by means of steam to dissolve the chemical. It takes 250 to 610 lb. of calcium chloride to prepare a solution for one 750-gal. tank wagon. One tank will cover 40,000 sq.ft. of surface.

Method of Water Sprinkling—The water-sprinkling wagons spray to a width of 27 ft. when full, gradually lessening to 18 ft. at the finish with sprays wide open. It requires 4½ min. to fill a 750-gal. tank at downtown hydrants, and a tank will empty itself in 12 min. traveling 1700 ft. and wetting an area of 40,000 sq.ft.

The sprays can be adjusted by the driver to decrease the amount of water, but practically covering the same width, and in this way a light sprinkling can be given, 750 gal. covering 60,000 sq.ft. of street surface in 16 min.

Office Work—The office work is carried on as follows: Each team route has a number and each section of street has a number. The inspectors make daily reports on special blank forms, showing district, route and street numbers sprinkled and the number of trips. These reports are sent directly to the chief record clerk and are recorded on check forms which have been prepared in advance for each route.

The route laid out for a team is definite and cannot be changed by the inspectors. The chief inspector, teamsters and district inspectors are given route sheets showing streets and limits that must be covered each day and the number of trips per day, and the teamster must cover the route. The office-check form shows the work laid out for each team and the daily reports show the work completed, or the reasons why it is not completed.

Cost—The total expense of all sprinkling service for the year 1912 was $100,410, which was assessed against the property owners, and against the street-railway company on streets having car tracks. The street-railway company pays a proportion of the cost based on the ratio of the street-car width to the total width of the street sprinkled or oiled; the street-car width is 2 ft. outside of the rail, or a width of street amounting to 19 ft. on double track. Approximately 5500 pieces of property were assessed for the 1912 sprinkling. The amount the street-railway company was assessed in 1912 amounted to about one-tenth of the total assessment.

CLASSIFICATION OF SPRINKLING EXPENSES, 1912, ST. PAUL, MINN.*

	Payrolls	Bills	Totals
Teams	$65,010.78	.....	$65,010.78
Inspection	6,333.13	.....	6,333.13
New standpipes	591.00	$650.17	1,241.17
Standpipe repairs	2,658.00	829.02	3,487.02
Equipment	.....	1,480.50	1,480.50
Equipment repairs	3,519.00	2,013.23	5,532.23
Oiling	1,901.75	6,320.18	8,221.93
Oiling equipment	.....	660.50	660.50
Assessment—Cost of	2,840.00	96.54	2,936.54
Calcium chloride	1,311.50	997.15	2,308.65
Totals	$84,165.16	$13,047.29	$97,212.45

* Actual expense to Sept. 1, only; Total to Nov. 15, estimated and assessed at $100,410.

Method of Assessing Cost—The assessment for oiling and sprinkling has to be in the hands of the county auditor on Oct. 10, and as it requires about five weeks to spread the assessment over the 5500 lots affected, using the regular office force, it is necessary to approximate the cost of the work for the year about Sept. 1. This is easily done, as the expense to Sept. 1 is known, and the expense for the balance of the year will be principally a payroll charge and is figured to Nov. 15. Expenses such as equipment repair have mostly been taken care of early in the year (all heavy repair work is done in February and March), and bills for material and oil are in or known by Sept. 1.

The cost of each form of sprinkling being known or estimated, the next step is to properly apportion the expense to the property benefited. Each street is sprinkled accordingly to its special requirements, 2, 4, 6 or 8 trips a day, and some streets requiring a trip down the center to cover, while others require two trips, one on each side of the street. Some streets are sprinkled the entire season, while others are not; and on macadam streets, water sprinkling is superseded by oiling in May or June. Paved streets are sprinkled with calcium chloride after freezing weather begins. Hence the cost of the three methods of sprinkling must necessarily be assessed separately.

In the apportionment of the cost of water sprinkling a factor or coefficient is introduced which may be called the "coefficient of benefit." This coefficient C is a product of the number of trips made per day over a certain section of street by the number of months or fractions of a month that section of street was sprinkled.

If a certain section of street were sprinkled four times a day from April 15 to Nov. 15, the coefficient of benefit would be $4 \times 7 = 28$. If water sprinkling were superseded by oil sprinkling June 1, the coefficient would be $4 \times 1.5 = 6$, or if the property owner should request additional sprinkling and the number of trips should be increased from 4 to 6 on, say June 23, then there would be two coefficients to be applied to the base rate, $4 \times 2.25 = 9$ and $6 \times 4.75 = 28.5$, expressing the parts of months in decimals.

The base rate for water sprinkling is determined as follows:

Y = total estimated cost.

R = base rate per ft.

R_1 = assessment rate per frontage ft.

C = coefficient of benefit.
F = frontages for each value of C.
$P = C \times F$.

Then

$$R = \frac{Y}{P_1 + P_2 + P_3 + P_4 \ldots + P_n}$$

and $R_1 = C \times R$.

There were 38 rates used in 1912 in assessing the water sprinkling, the cost per frontage ft. varying from 2.7c. for 2 trips per day to 10.8c. for 8 trips a day, for the sprinkling of the entire season; or a 50-ft. lot would be assessed $1.35 to $5.40 for the entire season, according to the number of trips.

The assessment for oiling is based on the total cost of oiling, total number of sq.ft. of street covered with oil, the number of times oiled, and the frontage.

The daily reports of oiling show the limits of oiling by streets. The office-map records show the widths and lengths of streets. As the widths vary, the rates also vary accordingly.

A = total cost of oiling divided by the total number of sq.ft. of surface oiled = cost per sq.ft.

B = length of streets of same width multiplied by their common width = areas oiled.

$C = A \times B$ = cost of oiling for each set of streets having a common width.

$D = C$ divided by the total frontage for each value of B = cost per frontage for each set of uniform width streets.

The cost of oiling per sq.ft. in 1912 was 0.152c., or approximately 1.4c. per sq.yd., for labor and material, including sanding. An average of 1/5 gal. of 40% asphaltic oil was used for one oiling, and 1 cu.yd. of screened dry sand covered 2900 sq.yd. of oiled streets.

Calcium-chloride sprinkling, which is resorted to on paved streets in freezing weather until the time of snowfall, is assessed in the same way as oiling, on a per sq.ft. basis. The cost of the chemical runs from $2 to $4.50 per tank of water, the amount used varying according to temperature. One sprinkling in moderately cold weather would cost $1.32 per 1000 sq.yd., or 0.3c. per frontage ft.

Prior to the year 1912, the total costs of all the sprinklings have been assessed as water sprinkling. This method saved considerable office work, but did not give a true and fair distribution of the cost. Calcium-chloride sprinkling is a special benefit to the business district, and oil sprinkling is confined to the macadamized streets. Where water sprinkling cost 2.7c. per frontage ft., two oilings would cost about 4c., or one and one-half times as much.

The method followed in spreading the 1912 assessment makes a charge to each piece of property of the actual cost of the benefit derived from any one or more of the three kinds of sprinkling used on the street in front of that property.

As a matter of expediency the water sprinkling organization does not handle the oiling or calcium-chloride sprinkling. The oiling is done under one of the street commissioners who is an expert in that work and who also sees to the cleaning and proper preparation of the roadway for the oil. The calcium-chloride sprinkling is handled by the same commissioner as he is more in touch with the conditions, has the confidence of the business men, and can act promptly as necessity arises; but all is done without friction in a very satisfactory way.

Under the city ordinances the street-railway company is required to sprinkle with water, oil or calcium chloride the portion of all streets occupied by their tracks; but as a temporary compromise the city has been doing the work for the railway company and the railway company accepts the city's bills. In 1912 the street-railway company paid nearly one-tenth of the total assessment. During this season, however, the railway company has equipped itself to do oiling and late in the season began oiling all of their tracks. They are now equipped to sprinkle with calcium chloride also.

COMPLAINTS—All complaints concerning the sprinkling service on any particular section of street are written upon the regular complaint form, with the name and address of the complainant. It is then the duty of the district inspector to call upon the complainant and make a thorough investigation of the complaint, and to return a written report to the chief record clerk. These complaints are given prompt attention and are then filed in numerical order with a corresponding reference number on the current assessment slips for future reference.

In case of a second complaint, or when the district inspector appears to be at fault or lax in the performance of his duty, or his report on the original complaint might be questioned, then it becomes the duty of the chief inspector to take immediate action and report his findings to the office engineer.

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Increase in the Foreign Trade of the United States—The figures made public by the Department of Commerce show that the foreign trade of the United States for the fiscal year ending June 30, 1913, exceeded that of the previous year by $421,000,000; the total trade for the past year amounted to $4,275,000,000, the greatest for any year in the history of this country. The value of the imports amounted to $1,812,000,000, and the exports to $2,465,000,000, making an excess of exports of $653,000,000. The greatest gain in exports was in manufactured articles ready for consumption, a gain of $105,000,000 over the exports for 1912. More than one-half of our foreign trade is with Europe, and our best customer is Great Britain; the next is Canada, with Germany third and France fourth.

A Profitable State Hydro-Electric Power Plant—The hydro-electric power station at the Wachusett dam of the Metropolitan Water Works of Boston, Mass., has generated and furnished power to the Connecticut River Transmission Co. under contract during the entire year 1912. The machinery was in active operation on 261 days, and for a considerable portion of the time power has been furnished in excess of the minimum amount which the contract required should be taken by the company. The operation of the plant has been entirely successful, and it has furnished electric energy to the Transmission Co. equivalent in amount to an average of 2937 hp. per 10-hr. day on the 261 days that the plant was in operation. Since the middle of October a small quantity of the electric energy generated has also been transmitted to the Clinton sewage pumping station. The cost of operating the power station has been $8995.66, and the State of Massachusetts has received from the Connecticut River Transmission Co. for the energy supplied a total of $30,297.95. The force employed includes one electrical engineer, one operator and two helpers who give all their time to the plant, and one helper whose time is divided equally between the station, the dam and the superintendent's office. Cost of operating the station was divided as follows:

Labor	$5521.07
Fuel for heating building	85.76
Repairs and appliances	354.46
Oil and waste	87.11
Small supplies	262.26
Taxes	2675.00
	$8995.66

The power was sold at $5.30 per 1000 kw.-hr., which is equivalent to about $10.30 per hp. per year.

[From the 12th Annual Report of the Metropolitan Water and Sewerage Board, 1912.]

Electric Welding for Track Repairs and Rail Joints

An interesting method now being employed to reduce the work and cost of track repairs and renewals on electric railways (especially in paved streets) consists in the use of a welding process to build up new metal in worn spots and so restore the part to its normal section. Work of this kind has been done on a number of roads.

Repairing worn frogs and special work in the track, instead of renewing them, not only saves the work of renewal (which is especially objectionable in paved streets), but prevents the loss or scrapping of material which is defective only in certain spots. Thus the crossing frog at an intersection may have the point so badly worn that it makes a rough riding track and is liable to cause derailment. Ordinarily the entire frog must be removed and scrapped, but if new metal can be welded on to form a new point, this loss is avoided.

FIG. 1. PORTABLE ELECTRIC WELDING APPARATUS FOR MAKING RAIL JOINTS AND TRACK REPAIRS
(Indianapolis Switch & Frog Co., Springfield, Ohio, manufacturer.)

The special feature of the process is that it requires no carbon electrode and separate piece of fluxing steel. The electrode is a rod of specially treated steel, and the arc between it and the rail (or other part to be repaired) fuses the electrode and welds it to the steel, building up new metal in the worn or defective places. The apparatus consists of a truck or light wagon equipped with ventilating rheostats for control of the voltage, current being taken by means of a wire hooked over the trolley wire at any desired point. The wagon stands at the side of the street, so that the work can be done with little or no interference with traffic.

An insulated handle is provided for holding the metal electrode, this being the positive, while the part to be repaired forms the negative. The electrode is placed in contact with the steel part and is then withdrawn slightly so as to form a short arc. This arc makes a pocket or cavity in the negative member and deposits molten globules of the electrode, this action continuing as long as the arc is maintained. The electrodes cost from 5 to 15c. per lb., and the amount required in each case ranges from a few ounces to a few pounds. Fig. 1 shows the work in progress on the track.

The welding process described above has been used by a number of electric railways. It is a specialty of the Indianapolis Switch & Frog Co., of Springfield, O., which company furnishes also an electrically operated portable grinding machine for finishing the welded work to a true level and smooth surface.

WORK IN CALIFORNIA

The process has been used extensively by the United Railroads of San Francisco, both in the track and the mechanical departments, and for particulars and photographs of this work we are indebted to E. D. Hibbs, General Superintendent. In the latter department it has been used for repairing and reclaiming various worn or damaged parts, such as truck frames, motor cases, gear cases, axles, axle bearings, armature shafts, brake levers, etc. We are informed that this work has resulted in saving many thousands of dollars. The track department has used the apparatus for repairing switch tongues, frogs and mates; for filling low spots or cups and corrugations in rails, and for filling low joints and repairing special work, as well as for applying welded splice bars. The photographs unfortunately make the work appear much rougher than it really is, the explanation being that the lenses of the camera appear to magnify the globular appearance of the surface of the new metal. In practice, also, the work is carefully ground to an even and smooth finish after the welding.

Fig. 2 shows the repair of cups or cutouts in the head of the rail, the photograph having been taken immediately after the welding operation and before grinding the new metal to surface. It will be noted that the metal was built up in the cup and then ground down level with the adjacent rail. On some railways such cups or low spots have been removed by grinding down the higher portion of the rail, but this has the objection of removing good metal and reducing the life of the rail. Fig. 3 shows hard-center special work that has been built up on the manganese-steel insert where it had become chipped, and on the rail which had cupped or hollow spots just beyond the insert. The crossings were in very bad condition and caused considerable complaint on account of the noise of the cars passing over these intersections. The welding operation made the crossing practically new, and is expected to prolong its life for several years.

In one case a badly worn frog point in a piece of special work was repaired, although this piece should have been replaced, as it was beyond reclaiming. However, it was rehabilitated and remained in service, thus illustrating the possibilities of the process. Fig. 4 shows an electrically welded built-up crossing. The rivet heads on the plates are merely to keep horses' hoofs from slipping, no bolts or rivets being used to put the parts together. This railway has used the process also on its cable lines, for welding rails to the yokes.

FIG. 2. HOLLOW SPOTS IN FROG FILLED UP BY ELECTRIC WELDING; UNITED RAILROADS OF SAN FRANCISCO
(The new metal has not been ground.)

The Pacific Electric Ry., of Los Angeles, Calif., has an equipment for this work, and Mr. Johnson, Acting Chief

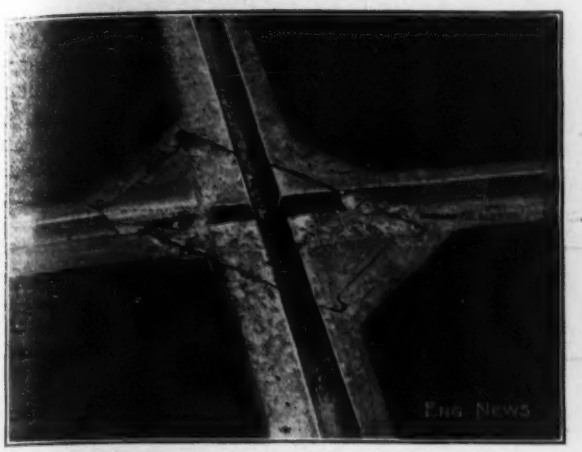


FIG. 3. CROSSING FROG WITH HARD-STEEL INSERT REPAIRED BY FILLING WORN SPOTS WITH NEW METAL APPLIED BY ELECTRIC WELDING

Engineer, informs us that it has kept this busy most of the time since its purchase. The work of building up cupped rails has been very satisfactory, and is estimated to have prolonged the life of crossings and special work from eight months to a year. It has not been used as yet on manganese special work, but from experience with the hard-center special work it is believed that it will work on this also. The machine can be used for cutting rails and boring holes in manganese rails. The operating cost to make a weld approximates $3. The company is using Mexican labor and finds that it does not require any special skill when once the men have been instructed how to operate the machine.

WELDED RAIL JOINTS

Another application of this process is in making rail joints by welding splice bars to the rails. The work is very much cheaper than by the Lorain process, described in our issue of Sept. 1, 1910, as the latter requires an extensive and costly plant (with generator, hydraulic grips, etc.) which occupies the track and interferes with traffic. Fig. 5 shows a specimen joint made by the Indianapolis process and subjected to test by the United Railways of San Francisco. It was suspended at points 6 ft. apart and had a load of 140,000 lb. applied at (*A*). The rails were forced as far as possible and were then reversed and the same pressure applied at (*B*), with the result as shown. The rails, when welded, were close together, and the separation shown is caused by the elongation of the plates. Upon close inspection after this severe test, it was found that the joint was in perfect condition, with the exception of a very short space at the point (*C*). The effects of the elongation on the plate indicate that the plate has about reached its elastic limit. In the track these joints are carried by ties spaced about 2 ft. c. to c., while in the test the supports were 6ft. apart. In a tensile strength test, a load of 380,000 lb. was reached before the joint showed signs of rupture.

An electrically welded rail joint and bond was placed in track of the above railway in February, 1912, and in order to give it as severe a test as possible the ties were left untamped. This joint was installed on the main thoroughfare, where (during the rush hours) a headway of 27½ sec. is maintained with cars weighing between 28 and 29 tons. With this unusually heavy traffic the joint was apparently in good condition after nearly 12 months'

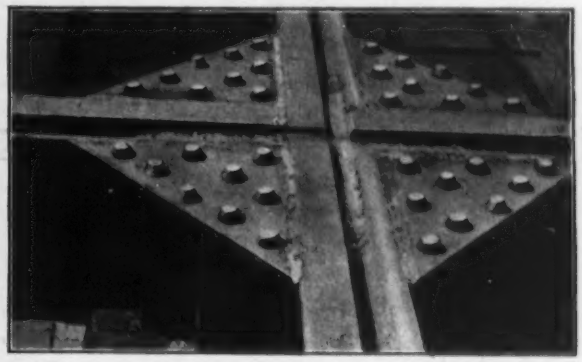


FIG. 4. BUILT-UP CROSSING FROG WITH WELDED CONNECTIONS AND WEAR PLATES
(The rivets are simply to prevent horses from slipping.)

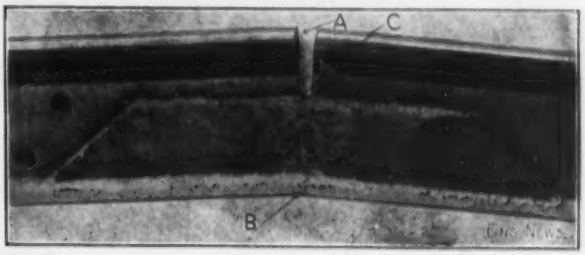


FIG. 5. RAIL JOINT WITH WELDED SPLICE BARS, AFTER BEING TESTED
(Made by United Railways of San Francisco.)

service and possessed greater conductivity than the usual bolted splice plate and copper-bonded joint. This company has in service over 400 electrically-welded compromise joints, connecting rails of two different sections, and has found them very successful.

City and Town Planning Boards in Massachusetts must be created by every city and also by every town having a population of more than 10,000 at the last preceding national or state census, according to an Act of the Massachusetts Legislature, which took effect immediately after its passage and approval on Apr. 16, 1913. These Boards are required to "make careful studies of the resources, possibilities and needs of the city or town, particularly with respect to conditions which may be injurious to the public health or otherwise injurious in and about rented dwellings." The planning boards are also required to "make plans for the development of the municipality with special reference to the proper housing of its people." The planning boards are to be appointed by the Mayor of cities or by the Commission in commission-governed cities, and in towns they are to be elected by the voters at the annual town meetings. Every planning board is required to report annually to the governing body of its respective city or to the voters of its town, "giving information regarding the condition of the city or town and any plans or proposals for the development of the city or town and estimates of the cost thereof." The governing bodies of cities are authorized by the Act, to "make suitable ordinances, and towns are authorized to make suitable by-laws, for carrying out the purposes of the Act," and the governing bodies in each case "may appropriate money therefor." The Homestead Commission (Chapter 607, Acts of 1911) is directed by the Act to call the attention of the town authorities to the provisions of the Act under review, and to furnish to those authorities such information as "may, in its judgment, tend to promote the purposes" of the Act under review, and also the purposes of the Act establishing the Homestead Commission.

Land Drainage in Louisiana

By A. M. Shaw*

The lands of the lower Mississippi basin which are naturally available for agriculture are confined to those bordering the river itself or its various bayous, these strips which are high enough above the tide water to permit gravity drainage being from a few rods to a mile or so in width. Back of these "high" lands are timber swamps and prairies which are very little above normal tide level. For a number of generations, efforts have been made to add to the available lands of this section by protecting and draining these low lands. In the early days canals were dug and levees were built by hand under conditions that would now be considered impossible. The shovel and the wheelbarrow have little place in the reclamation of the wide stretches of prairie lands that are now being drained. Labor has become too expensive and the projects too large for the use of anything but the most modern methods and equipment.

Owing to the high wind-tides which may cover the land for a depth of 4 or 5 ft., the construction of the outer protection levee is the most important work on many of the projects. There is a wide difference in the requirements in this respect, however, some of the lands being specially exposed and others so situated that they are practically immune from overflow from back water.

Levee construction on the trembling prairies is especially difficult on account of the unstable nature of the material which forms the levee and its support. A typical section of this land would show 2 to 4 ft. of muck or humus with a "sharkey clay" subsoil. The muck varies from an almost pure product of decayed marsh grasses and water plants to a soil made up of decayed vegetable matter mixed with a considerable percentage of river silt. The lands lying in direct line of the overflow from the Mississippi River and its bayou outlets contain the larger proportion of silt. The presence of this river deposit in the top soil is especially valuable during the first few years of development, as it furnishes a complex soil which assists in plant growth until such a time as the humus has become thoroughly decayed and the plant roots are able to penetrate to the clay subsoil.

Types of Dredging Plants

It has been found that each section presents its individual problems, and an attempt to handle work with an outfit not adapted to local conditions will result in excessive expense if not in failure. For instance, in the southwestern Louisiana prairies it is feasible to use the dipper type of dredge commonly used in canal construction in the North, the dredge having bank spuds and a comparatively short boom. In the soft prairies encountered principally east of the Atchafalaya River, grab-bucket dredges with long booms and vertical spuds are most successful.

In general it may be said that the orange-peel dredge excels in handling the clay and muck of this locality and lends itself more readily to the various demands of levee building, while the dipper dredge is preferable for digging in hard sand and large stumps. Outside of the cypress, however, stumps are seldom encountered which interfere seriously with the operation of the larger orange-peel dredges.

A gravity-swing dredge of the orange-peel type, which was built by the writer in 1911, is used by the Phillips Land Co., in the reclamation of its 85,000-acre tract in St. Bernard and Plaquemines parishes. This has an 80-hp. boiler, a Worthington condenser, and 10x12-in. special dredge engines built by the Clyde Iron Works, of Duluth, Minn. The main drums are placed 16 ft. apart, thus securing the necessary spread for gravity swing. Three auxiliary drums are mounted on a separate shaft and are used for raising the two spuds and for overhauling the "pull ahead" line, which is fastened permanently to the 1½-yd. bucket. The boom is of steel, 75 ft. long.

The hull is 34x70 ft., built of long-leaf yellow pine. All machinery is placed down in the hull. The A-frame is of pine, while the house is of steel construction, covered with heavy galvanized corrugated iron. A ventilator built over the entire length of the house adds somewhat to the expense, but results in a great increase in comfort, which is an important item in this climate. Except when the wind is blowing from the stern, the heat from the boiler is seldom noticeable in the forward portion of the dredge, owing to this ventilation.

A dipper dredge is also owned by the Phillips Land Co., and is used in digging canals and building levees through cypress lands. This was built by the American Steel Dredge Co., of Ft. Wayne, Ind. It is equipped with a 75-hp. boiler, 10x12-in. main engines, 70-ft. boom and 2½-yd. dipper. The hull is 36x100 ft. and 7 ft. deep. In digging through timber lands with this dredge, considerable difficulty was encountered by the jamming of logs and stumps in the dipper. These were usually extracted by means of a chain which was left hanging from the point of the boom. Whenever it was impossible to free the bucket by a quick pull on the backing or swinging line, it was hoisted as high as possible, the chain fastened to the log by means of a trip link and the bucket lowered away.

The writer appreciates the fact that there are many readers of Engineering News who are familiar with this method of extracting timber from dippers. But it is worth while to call attention to it, as it is still a common sight to see an entire dredge or steam-shovel crew work for an hour or more in an effort to free the dipper from a bad stump by means of bars and axes. Dynamite has been used for this purpose, but probably not more than once in the same bucket.

On most dredges, swinging either by gravity or by means of independent swinging devices, the height of the boom is fixed by the angle and position of the sister sheaves guiding the main hoisting lines. It is often desired, however, to change the working radius to suit special conditions. A gravity-swing dredge with this adjustable feature has been developed by the Jahncke Navigation Co., of New Orleans, and is shown in Fig. 1. It has been in successful use for a number of years in land reclamation work and in the construction and maintenance of a number of navigation canals of this locality. It has two return-tubular cylindrical boilers, externally fired, each 3½x22 ft. The Greenwald dredging engine has cylinders 14x16 in. and there is a separate double-cylinder (7x10-in.) engine for hoisting spuds and swinging.

*Engineer for the New Orleans Lake Shore Land Co., 1003 Hibernia Bank Bldg., New Orleans, La.

Two spuds are 16x16 in., 46½ ft. long. The other is 14x16 in. The hull is 37x112x7½ ft.

The boom swinging line is continuous, passing from one side of the boom over a sheave whose plane of rotation intersects the boom point and is perpendicular to a fore-and-aft vertical plane. From this sheave it passes over a sheave lying in a vertical plane, thence down to a drum, up again to a third sheave hanging in the bight, and so through a precisely similar set of sheaves and

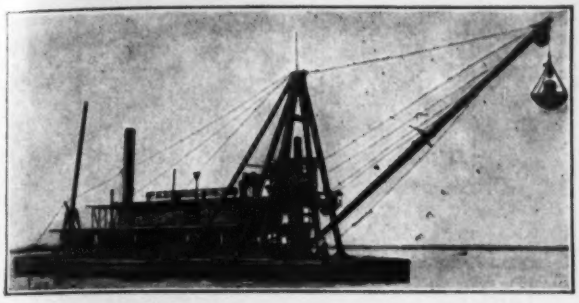


FIG. 1. GRAVITY-SWING GRAB-BUCKET DREDGE FOR DRAINAGE CANAL EXCAVATION IN LOUISIANA

drums and back to the opposite side of the boom point. The operating lines lead from each side of the boom over a stiff swivel sheave swinging about a hollow, vertical, tangent axis, then over a fixed sheave tangent to the same axis, and so down to the operating drum. The swivel sheaves described are similar to the "rooster" top of a stiff-leg derrick. They adjust themselves freely to any position of the hoisting lines, giving a fair lead from the point of the boom.

DREDGES FOR INTERIOR CANALS

In order that the size of pumping plants used in the reclamation of these lands may be kept within reasonable limits, it is necessary that a considerable storage capacity for rain water be provided. If the area does not include natural bayous or lakes of good depth, a storage basin must be supplied artificially. For reasons of economy, this basin usually takes the form of a system of canals which serve also as a collecting system radiating into every portion of the tract to be drained.

In the construction of such interior canals, various types of dredges have been used. Small ladder dredges have done efficient work at low cost, though the work of the hydraulic dredge is generally preferred on account of the fact that the excavated material is discharged over such a large area. In this way, mineral matter from the sub-soil is furnished to a considerable portion of the top soil which may be somewhat deficient in such elements.

Ladder dredges of the Menge type have been used on work of this kind. One of these, used by Theodore Wilkinson, of New Orleans, has a hull 22x60 ft., with the ladder swinging to either side to cut a canal 35 ft. wide. The distance from center line of boat to end of discharge apron is 40 ft., and the velocity of discharge is usually great enough to cast the material about 10 ft. farther. The ladder has 32 buckets of about 6 cu.ft. capacity each. The boiler is of 50 hp. and the engine has two cylinders 11x16 in. The average monthly output is 24,000 cu.yd. The coal consumption is 1½ to 2 tons per shift of ten hours. The cost to operate the machine (on single shift) is about $650 per month. The cost of the machine is about $10,000.*

Fig. 3 shows the hydraulic dredge "Louisiana," owned by the La Fourche Dredging Co. In the first unit reclaimed by the Phillips Land Co., which contained about 2500 acres (Fig. 3), this dredge excavated 18 miles of canals varying from 22 to 75 ft. wide and from 7 to 9 ft. deep. In cutting the smaller canals, which included the greater portion of the work, the dredged material was discharged in equal quantities on each side of the canal through pipes 50 ft. in length. These pipes were suspended rigidly from shear legs, as shown.

In some places it was found necessary to build low levees by hand to prevent back flow of the discharge into the canals before the solids had been precipitated, but in many portions of the tract the swamp grass was sufficiently dense to retard the flow of excavated material back into the canals. Some advantage was also secured by leaving an opening in the under side of the discharge pipes at a point 10 or 15 ft. from the ends. This permitted some of the heavier material to drop and form a slight ridge. The discharge from these openings is shown in Fig. 2.

The pumping plants now being installed usually consist of one or more centrifugal pumps varying in size from 24 to 60 in. discharge, though pumps are now being built for the Plaquemine-Jefferson Drainage District with a nozzle diameter of 84 in. Pumping plants are usually erected simultaneously with the construction of the levees and interior canal systems, so that drainage operations may begin as soon as possible after the tract is inclosed.

POWER PLOWS FOR EXCAVATING DITCHES

With main drainage canals spaced ¼ to ½ mile apart, it is necessary to put in small field drains at frequent

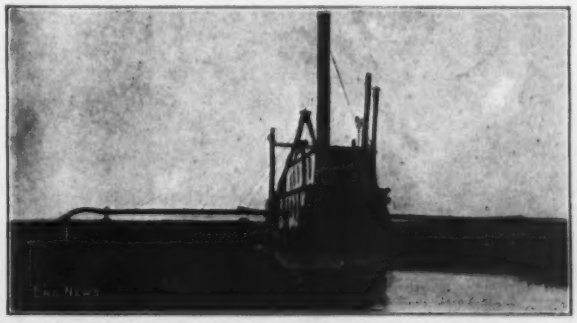


FIG. 2. HYDRAULIC DREDGE EXCAVATING A DRAINAGE CANAL AND BUILDING LEVEES

(There are two discharge points in each delivery pipe, to give a wider base for the discharge.)

intervals to properly drain the soil. Tile drains have been used for this purpose to a very limited extent but have given excellent results. Open ditches are preferred, however, for the first drainage, as they can be put in

*The Menge ladder dredge was built formerly by Woodward, Wight & Co., of New Orleans, but they inform us that they have ceased to manufacture it, as the cost is much greater than that of other types. They state further that in open swampy prairie lands a ladder dredge can do twice as much work as any other type, but that where the soil contains much clay this will stick to the bucket and will not dump. There is also some trouble where stumps or cypress roots exist in considerable numbers.—Ed.

cheaply and quickly, before the ground has become sufficiently firm to permit tiling operations. On many of the prairies it has been possible to work with a caterpillar traction ditcher as soon as the surface water was removed by the main canals. On others, this was impossible, and the only alternative seemed to be hand work or the use of some sort of ditching plow operated from barges.

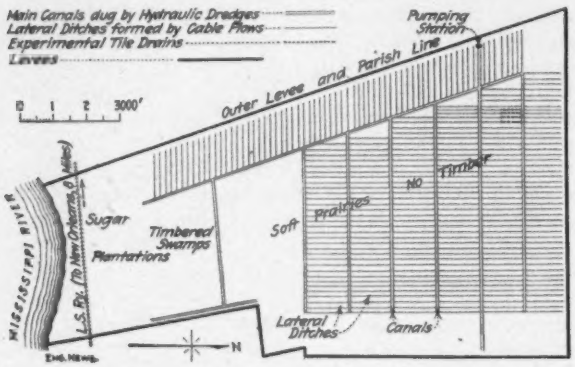


FIG. 3. PLAN OF CANAL AND DITCH SYSTEM FOR THE DRAINAGE OF A TRACT OF SWAMP LAND IN LOUISIANA

On the Phillips Land Co. project the latter plan was followed. The regular spacing of the canals made this especially easy, and the general arrangement of canals and ditches is shown in Fig. 3. The outfit used consisted of the following: (1) two barges, 16x20 ft., 3 ft. deep; (2) a special compound-geared pulling engine made by the Clyde Iron Works; (3) two lengths of ¾-in. steel cable, each 1350 ft. long; (4) one length of light messenger cable; (5) one ditching plow. The engine had cylinders 7x10 in. and its 50-in. forward drum was driven by a friction clutch on the intermediate shaft. The vertical boiler (4x9 ft.) carried 100-lb. pressure, and the weight of boiler and engine was about 9 tons.

FIG. 5. CABLE-OPERATED PLOW FOR EXCAVATING DRAINAGE DITCHES
(The plow is just starting a lateral from a main canal.)

The method of working is shown in Fig. 4, and was as follows: Two main canals were excavated at a distance of about 1200 ft. apart, and the land between them was opened by a series of ditches connecting the two main canals. A ditching plow was floated on one of the canals, while on the other canal was floated a barge with the ditching engine. A steel cable ran from the plow to the forward drum of the engine, which was capable of exerting a 20,000-lb. pull. This drum was of cast steel, and 50 in. long between the flanges. Its function was to pull the ditcher through the intervening 1200 ft. of ground which it did at a speed of 3000 ft. per hr.

Another cable ran from the rear drum of the engine through a snatch block on the farther bank of the lower canal, and thence to the rear of the plow. This latter drum (single-geared) exerted a pull of 8000 lb. and hauled the plow back through the newly dug ditch to the

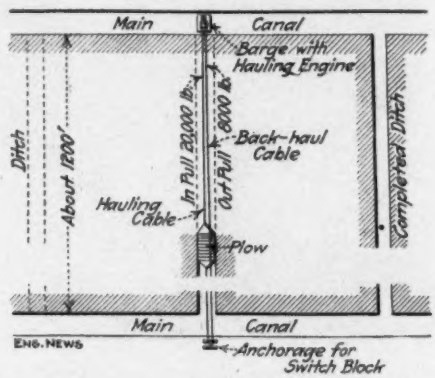


FIG. 4. DIAGRAM SHOWING METHOD OF EXCAVATING DITCHES BY A CABLE-OPERATED PLOW

canal, whence it was floated down to the next proposed ditch and the operation was repeated.

The plow first used was built by the Glencoe Foundry & Machine Co. (Glencoe, Minn.), and worked well in hard and moderately firm soil. It proved too heavy, however, for the softest prairies and it was necessary to build a plow of lighter weight, both to prevent cutting too deep in the soft lands and to facilitate moving from one ditch to the next. The first plow built was a crude affair but worked economically and quite satisfactorily. It is shown by Fig. 5, but the view does not show the

FIG. 6. REAR VIEW OF POWER PLOW MAKING THE FIRST CUT FOR A LATERAL DITCH
(The cable in the foreground is the tail or back-haul rope.)

long steel coulter which was attached to the under side of the cypress log (forming the central part of the plow) by means of a hinged joint.

This coulter was made from a steel bar about ¾ in. thick, 4 in. wide and 4 ft. long. The pulling cable was attached to the top, while another cable (also attached to the top of the coulter) was carried back to an adjustable hitch on the top of the center log. This latter cable was used in regulating the depth of cut. With this device it was possible to dig ditches in any soil encountered,

though in the softest ground it was necessary to pass the plow through the second time to secure satisfactory results. It was found advisable to allow a couple of weeks to elapse between the two operations. With partial drainage secured by the first shallow ditches, there is less caving of the banks when the deeper cut is made.

It has not been found practicable to cut a ditch more than about 30 in. deep with this device and it lacks the adjustable features of the more elaborate ditching machine, but it has the following advantages: (1) low first cost; (2) economy of operation; (3) simplicity; (4) easily transferred, as the plow is pulled into the canal and floats from one ditch to the next.

In addition to the foregoing, this plow has an important field of operation not satisfactorily served by any other class of equipment. By its use, the complete reclamation of the soft lands can be hastened and the lands prepared for cultivation several months earlier than could be done if it were necessary to wait for partial drainage by main canals and for favorable weather to improve soil conditions so as to permit ditching by other means.

During one month, 156 quarter-mile ditches were cut with the plow, each ditch being gone over twice. The ditches averaged about 30 in. deep, 2 ft. wide at the bottom and 3 ft. wide on top. The cost of operating the plow, including repairs, fuel, etc., amounted to about 5c. per cu.yd. A crew of 10 to 12 men was required as there was a considerable amount of heavy work in pulling the messenger cable across and in clearing the plow. Some ditches were cut through their entire length without stopping to clear the grass from the coulter, while at other times it was necessary to stop 10 or 12 times for this purpose. On the first cut, a cable was kept attached to the rear of the plow so that it could be pulled back to permit clearing from trash. A few submerged logs were encountered which had to be cut out or blasted, but usually the only obstruction was the heavy marsh grass.

In order to insure proper alignment of ditches, it was necessary to clear a line through for the men who carried the messenger cable. Any deviation from a straight line in stretching this first line resulted in a corresponding swing in the line of ditch as the grass was stiff enough to hold the pulling cable from assuming a straight line when under strain. Fig. 6 shows the plow making a first cut. Slight errors in line are corrected by shifting the men from one side of the plow to the other.

Railways in the United States in 1912

The Interstate Commerce Commission has just issued a report covering the statistics of railways in the United States for the fiscal year ending June 30, 1912. The following is an abstract:

On carriers having gross operating revenues of $100,000 or more there were 240,238.81 miles of line operated. The aggregate mileage of railway tracks of all kinds covered by operating returns for these roads was 360,714.24 miles, classified: single track, 240,238.81 miles; second track, 24,929.51; third track, 2511.76; fourth, fifth and sixth tracks, 1783.97; yard track and sidings, 91,250.19; an increase of 8925.52 miles over corresponding returns for 1911 in the aggregate length of all tracks, of which increase 3167.42 miles, or 35.49%, represent yard track and sidings.

The average number of locomotives per 1000 miles of line was 255, and the average number of cars per 1000 miles of line, 9860. The number of passenger-miles per passenger locomotive was 2,263,019, and the number of ton-miles per freight locomotive was 7,077,428. The returns indicate that the number of locomotives and cars in the service of the carriers under consideration aggregated 2,429,908.

The total number of persons reported as on the pay-rolls on June 30, 1912, was 1,699,218, or an average of 707 per 100 miles of line. As compared with corresponding returns for June 30, 1911, there was an increase of 45,987 in the total number of such railway employees. The total amount of wages and salaries reported as paid to railway employees during the year was $1,243,113,172.

The par value of the amount of railway capital outstanding was $19,533,750,802. This amount includes capital held by the railway companies concerned, as well as by the public. Of the total amount of such capital outstanding there existed as stock $8,469,560,687, of which $6,882,813,008 was common and $1,586,747,679 was preferred; the remaining part, $11,064,190,115, representing funded debt, consisted of mortgage bonds, $8,019,700,886; collateral trust bonds, $1,279,128,266; plain bonds, debentures and notes, $1,067,567,350; income bonds, $263,441,054; miscellaneous funded obligations, $116,170,300; and equipment trust obligations, $318,182,259.

Of the total capital stock outstanding for the roads under consideration, $2,909,693,873, or 34.35%, paid no dividends. The amount of dividends declared during the year (by both operating and non operating companies represented in this statement) was $400,432,752, being equivalent to 7.20% on dividend-paying stock. The average rate of dividends paid on all stocks outstanding pertaining to the roads under consideration was 4.73%. No interest was paid on $808,464,701, or 7.52% of the total amount of funded debt outstanding (other than equipment trust obligations).

The increase in the ton mileage for the year ended June 30, 1912, over the returns for 1911, was 9,499,215,886. The number of tons carried one mile per mile of road for the year ended June 30, 1912, was 1,108,578, as against 1,088,314 for the preceding year. The average number of tons of freight per train-mile was 409.29. The corresponding figure for the preceding year was 386.17.

The average receipts per pasenger per mile, as computed for the year ended June 30, 1912, for the roads covered by this statement, were 1.985c.; the average receipts per ton per mile, 0.743c. The passenger-service train revenue per train-mile was $1.30.404; the freight revenue per train-mile was $3.04.015. The average operating revenues per train-mile were $2.30.201. The average operating expenses per train-mile were $1.59.544. The ratio of operating expenses to operating revenues was 69.30%.

The operating revenues of the railways for the year ended June 30, 1912 (average mileage operated 237,809.09 miles) were $2,826,917,967; their operating expenses were $1,958,963,431. The corresponding returns for 1911 (average mileage operated 234,366.14 miles) were: operating revenues, $2,772,733,828; operating expenses, $1,901,399,475. With minor eliminations the operating revenues per mile of line operated (including lines operated under trackage rights) averaged $11,881 and operating expenses $8234 for the year.

Pumping a Mixture of Coal and Water is one of the features of the coal-storage and conveying plant for the electric power station, upon the construction of which bids are about to be invited by the Hammersmith (London) Borough Council. The plan as described in the London "Times" of July 16, involves the laying of an 1800-ft. pipe line between the wharf where the coal is received and the storage site, the purpose being to deliver the coal hydraulically into the storage tanks where it will be stored under water. The coal will be lifted out of the barge by a Priestman grab bucket and delivered to an automatic weighing machine, thence into a hopper from which it will be automatically fed into a suction tank by a centrifugal suction dredger pump. Water will be fed into this suction tank either from the main circulating pipe, delivering water to the station, or from the return pipe from the coaling tank. The dredger pump will deliver a mixture of coal and water (15% of the total volume being coal) to the pipe line, and maintain a velocity of 7 ft. per sec. in the pipe. From the pipe the mixture will be delivered to an auxiliary cooling tank and, if desired, to the main storage tank. At both tanks, pumps for returning the water by means of the return pipe to the wharf, will be provided. Mechanical coal-handling apparatus will remove the coal from the acceptance tanks to the bunkers. The cost of the proposed five storage tanks is estimated at about $37,000; the steel pipe line and pumping plant, $10,000. The present cost of handling coal from the dock to the power plant is about 14c. per ton; it is estimated that this will be reduced to not more than 2c. per ton by means of the hydraulic power system. It is stated that the plant will be in operation within six months.

Prize Design for Coney Island Beach Reclamation

In our issue of Feb. 20, 1913, we published a problem in beach reclamation proposed by the Brooklyn Engineers' Club, with the conditions governing a prize competition for the best design for the solution of the problem. The competition recently closed, and the first prize was awarded to George E. Jackson, of Brooklyn, N. Y. The accompanying plans and description give what the judges have decided is the most feasible scheme proposed out of some 20 odd designs which were submitted.

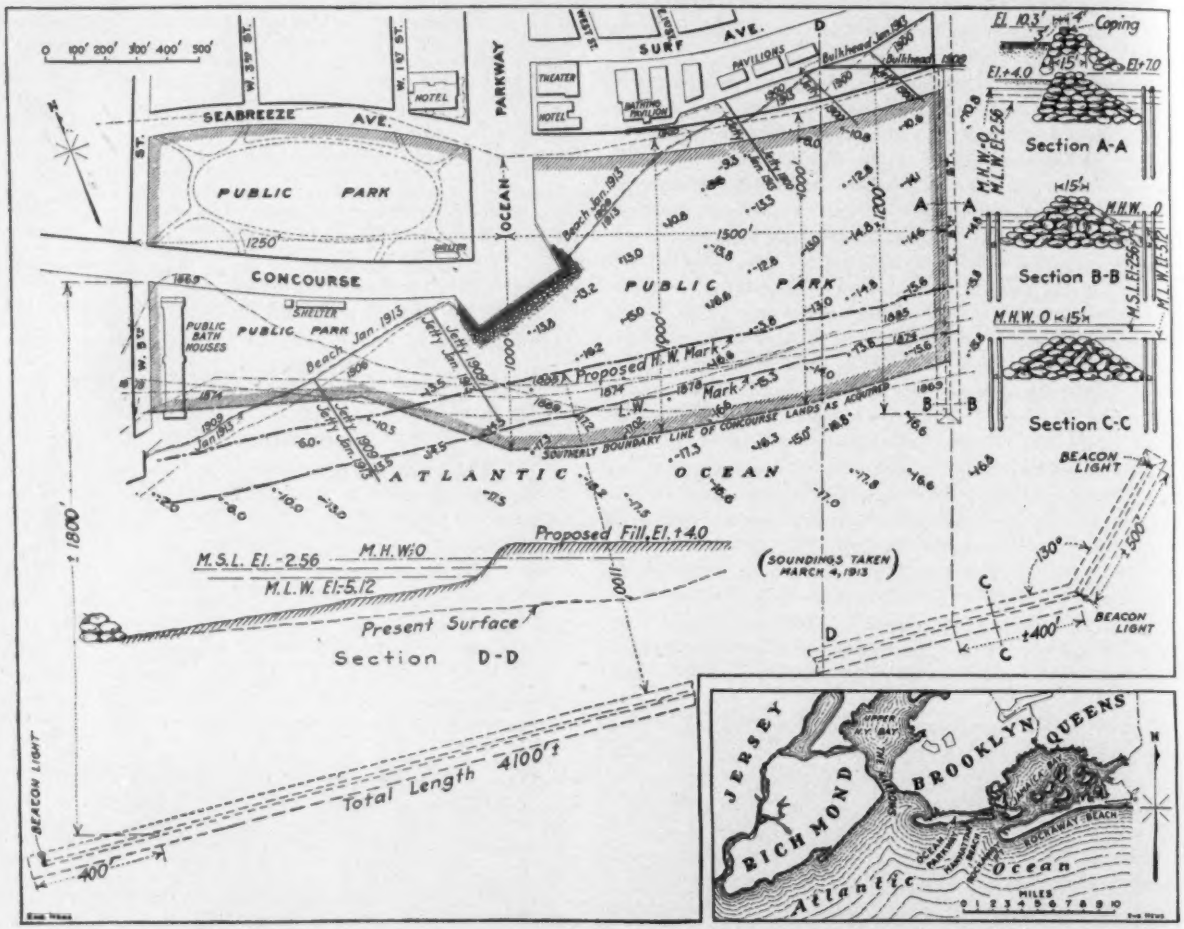


FIG. 2. PLAN OF GEORGE E. JACKSON FOR RECLAIMING CONEY ISLAND BEACH

FIG. 1. MAP OF PART OF SHORE OF LONG ISLAND IN VICINITY OF CONEY ISLAND

Mr. Jackson, of course, had the advantage of being able to study the conditions at first hand, and he has come to the following conclusions: Great erosions have taken place in past years along the south shore of Long Island in the vicinity of Coney Island, New York City, which is manifest by the recession of the beaches. This erosion takes place for the most part under the action of the southeast storms. The waves breaking on the shore wear away the sand, which is carried down by the undertow and drifted away by the tidal currents.

During the past 40 years, Rockaway Point, on the east (see Fig. 1), has grown about 3 miles in a general westerly direction by the accumulation of drift under the action of the flood tide, which is the active element in the transportation of beaches. Between Rockaway Point and the shoals to the west a gateway is formed, and during inshore gales and southeast storms waves are forced along the foreshore and the beaches are depleted. With the constant westward advance of Rockaway Point the area of attack has also grown westward until the portion of the Coney Island shore between East 5th and West 5th Sts. (Fig. 2) is about the center of attack, and if left unprotected will be further eroded and depleted.

Since the completion of the seawall running north and south along the Manhattan Beach Estates (east of Coney Island), there has been a shoaling of the water at the foot of the wall so that scows can no longer moor alongside. The jetties just east of Ocean Parkway (Fig. 2) have not collected any sand, while those to the west have filled with sand to the tops on the windward sides, and on the leeward sides of the same jetties the sand is about 10 ft. lower. These conditions in connection with other characteristics have shown that no littoral drift comes to the shore within the limits of the beach included in the problem on account of the direction of the currents.

To the west and north of Rockaway Point there is a deep channel which is maintained by the currents. At the first of a flood tide the water flows through this

channel and fills the 25 sq. miles of Jamaica Bay. About the same time the tidal currents follow a general circuitous path to the northeast and northwest, the latter becoming tangent to the shore at about West 8th St. (west of the beach shown in Fig. 2). It thus appears that the waves reaching the shore between East 5th and West 5th Sts. are principally wind waves and not waves of translation; and under these conditions it would not be possible to build a beach by the use of low or high groins.

The following method is suggested:

(1) Build a seawall at East 5th St., following the general direction of the street.

(2) Pump sufficient sand to make a beach to about the lines and grades shown on the plan, Fig. 2.

(3) Protect the beach thus reclaimed with a hurdle or low breakwater, the top to be about one foot above M.L.W. The ocean waves reaching the shore during a storm undulate in an orbit, one object of this low breakwater is to interfere with the undulation and cause the wave to break at the barrier and not on the shore. This would also act as a footing for the new slope of beach and prevent any scour.

Specifications

Rock—It is proposed to build the seawall and breakwater in rubble-mound form of rock as it comes on the work from one-man size to large derrick stones.

Piles—Selected spruce piles of sufficient length and with a diameter of not less than 6 in. at the point and 14 in. at the butt. All the piles called for are to be placed in two rows staggered 3 to 4 ft. c. to c. at the foot of the riprap slopes and have a penetration of not less than 20 ft.

Seawall—The seawall (Sec. A-A, B-B) is to be built of rock for about 1200 ft., southerly from the bulkhead now in place, following the line of East 5th St. to an elevation of about 7 ft. above M.H.W., and have a slope not less than 1½ on 1 on all sides except that portion on the west, which will have a natural slope between the bulkhead and the new H. W. mark indicated on the plan. This portion of the slope is to hold the sand fill, and a sufficient quantity of cinders or ashes should be dumped on the slope as the filling proceeds to protect the sand from leakage through the stone. Two staggered rows of piles are to be placed at the foot of all rock slopes except that portion on the west between the bulkhead and the H. W. mark. The top of the wall will have a mean width of 15 ft.

After the wall has fully settled it is proposed to put a reinforced-concrete coping 4 ft. wide, and 3 ft. high on a bed of concrete; the coping is to be 3 ft. from the west side and run the entire length of the wall.

Breakwater—The breakwater will be built of rock, as shown in Section C-C, to an elevation of 1 ft. above M.L.W. The top is to have a mean width of about 15 ft. and slopes of not less than 1½ on 1, protected at the foot with two staggered rows of piles placed from 3 to 4 ft. c. to c. The proposed location is indicated on the plan (Fig. 2). A suitable beacon light is to be placed at the ends and at the angle of the breakwater.

Sand Filling—The filling is to be done by pumping sand with modern hydraulic suction dredges, and the area reclaimed is to have an elevation of +4 ft. extending southerly so as to bring the H. W. mark to about the line indicated on the plan—allowing the overflow to run down the beach and assume a natural slope.

Estimated Cost—A seawall and breakwater built of concrete on a suitable foundation would be in keeping with the best form of construction, but its cost was thought to be prohibitive. As the supply of rock is abundant and the price reasonable at the present time, the rubble-mound form of construction is suggested. The total cost is estimated as follows:

Seawall-rock		
1 ft. settlement allowed, 42,400 cu.yd. at 50c.	$21,200.00	
Spruce piles		
3½ ft. c. to c. 1030 at $12	12,360.00	
Coping		
680 cu.yd. reinforced concrete, at $7	4,760.00	
Cinders or ashes		
1000 cu.yd. at 20c.	200.00	$38,520
Breakwater rock		
1 ft. settlement allowed, 8600 cu.yd. at 50c.	43,000.00	
Spruce piles		
3½ ft. centers 4840 at $12	58,080.00	
Beacons		
3 at $1000	3,000.00	104,080
Sand fill		
About 26.5 acres to El. +4 ft. allowing for slope to extend as far as breakwater, 1,200,000 cu.yd. at 10c.		120,000
Total		$262,600

The Limitations of Engineers*

By A. O. Powell

What are the duties and the limitations of engineers in active practice; to what degree should they confine themselves to specialties, and what should be their attitude toward associates in other branches of enginering work, to clients and to contractors?

Self confidence is a most admirable and necessary trait, when kept under proper control, but if unrestrained leads to the assumption of responsibilities that the natural aptitude, training and experience of the individual may not have qualified him for.

How many consulting engineers have the moral courage to decline a retainer fee for service outside of their legitimate field on the ground that they are not specializing in that line of work; or will consistently refrain from advising a client to have the construction work performed by day labor under the management of the engineer?

Fortunately the number of men is increasing who will confine their labor for pay to the classes of work they have studied, and grown most proficient in. The profession should aim to augment the number. It is only the geniuses who are capable of solving structural, hydraulic, electrical and sanitary problems with the same degree of ease and effectiveness.

It is doubtless difficult for the layman to differentiate between experts in different lines, but his opportunity for a fitting choice would be enhanced if he felt secure in obtaining a frank admission from the first engineer consulted as to whether the work was included in his line of specialties; and if not, could rely upon being advised of the names of men who were qualified. It is also no easy matter to select an engineer for a large city. Few positions involve a wider range of technical work than falls to the lot of the city engineer. No one expects him to be an expert in all branches. In the majority of cases, he is primarily a sanitary and road engineer and should be great enough not to show any hesitation in advising the employment of specialists on the occasional large projects that are without his sphere of experience. The authorities should admit the reasonableness of the request and if the request is not made, should initiate action themselves.

That the city fathers have an inchoate understanding of expertness is evidenced in the engagement of the so called efficiency engineers. Men armed with a stop watch in one hand, a bundle of forms in the other, who profess to be able to correct all the ills of every conceivable enterprise—the very embodiment of the evil I am decrying. There never was a large undertaking, that the critic, if he searched long enough, could not find among the innumerable items, an array of alleged abuses that appalls the inexperienced. The true efficiency expert is the expert contractor, the expert accountant, the expert lawyer and engineer in their specialties and so on through the entire list. Each is efficient in his own field. There is no such thing as the universal efficiency expert.

*Extract from Presidential Address before the Pacific Northwest Society of Engineers.

Timber Buffers for Protecting Vessels Entering the Panama Canal Locks*

For protection against possible injury to vessels entering the Panama Canal locks, special timber buffers, wedge-shaped, are to be built in crib construction at the ends of the center approach or guide walls. The fenders for the sides of the approach walls and flare walls were described in "Engineering News," of Nov. 2, 1911.

The buffers for the six guide walls of the three sets of locks will be generally similar in construction, but their supports will vary according to conditions. Each buffer will project 65 ft. from the end of the wall. The wedge-shaped part will be 42 ft. deep, with each face about 50 ft. long. In rear of the wedge, cribbing will be built on either side to extend back about 23 ft., and embrace the end of the guide wall.

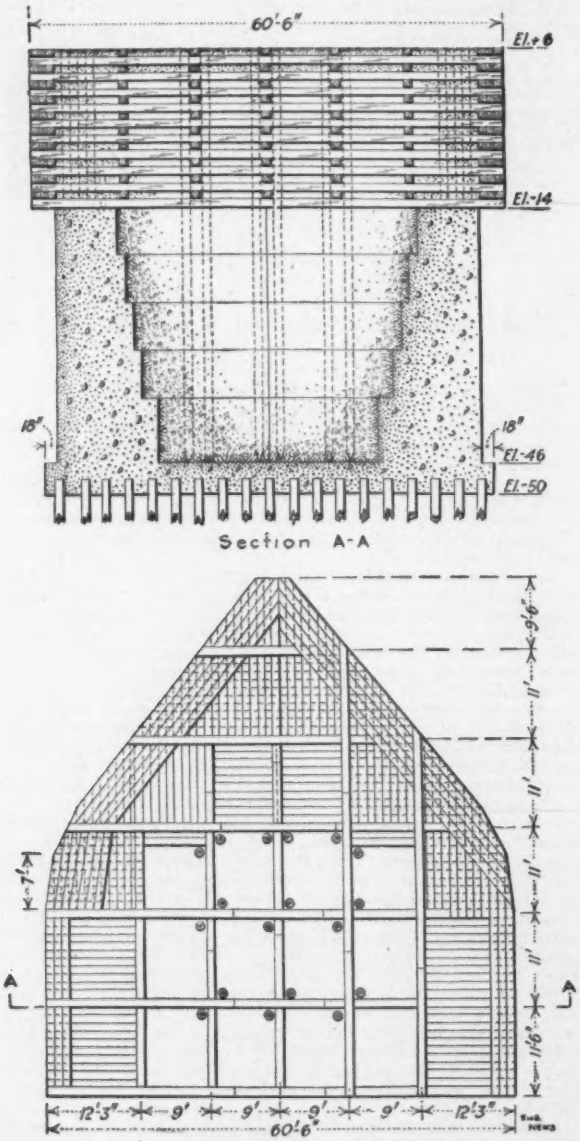


FIG. 1. PLAN AND ELEVATION OF TIMBER BUFFERS, LOWER APPROACH WALLS, GATUN AND MIRAFLORES LOCKS, PANAMA CANAL

The crib construction will be a facing around the interior support and will be about 5 ft. thick. It will consist of 12x12-in. timbers, dovetailed in the style of a log cabin, and the face will be made solid, with about 7 ft. overhang, by the interposition of extra timbers laid lengthwise.

Three types of supports will be used, determined by the degree of cohesiveness of the earth at the ends of the walls and depending upon whether the surrounding water is fresh or salt.

LOWER ENDS OF GATUN LOCKS AND MIRAFLORES LOCKS

The cribs at the ocean ends of these locks are the ultimate type to which the others will eventually conform. The crib work will rest on a firm base of monolithic concrete, and will be anchored by upright timbers to prevent side thrusting. The base will be a wall 52 ft. high, joined to the ends of the existing approach walls. The wall will be 13 ft. thick at the base, vertical on the outside, but stepped-in on the interior to a thickness of 8 ft. at the top. The plan and elevation of wall and surmounting crib are shown in Fig. 1.

At Miraflores, the base will rest on solid rock; at Gatun, the material at the outer end of the lower approach wall is soft mud in a layer as deep as 60 to 70 ft. above rock, and the concrete base wall for the crib will rest on piles, as the greater part of the approach wall itself does. The piles will be driven to rock, on 3-ft. centers, and surmounted over all by a binding cap of concrete, 3 ft. thick.

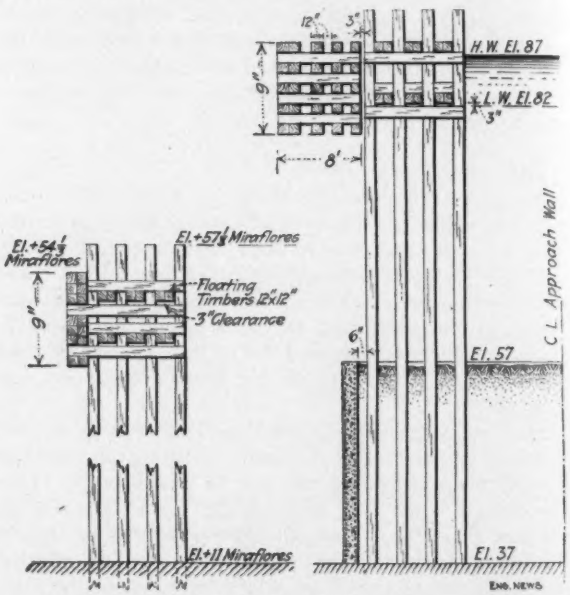


FIG. 2. CRIB CONSTRUCTION AT UPPER APPROACH WALL, MIRAFLORES LOCKS

FIG. 3. CRIB CONSTRUCTION AT UPPER APPROACH WALL, PEDRO MIGUEL LOCKS

UPPER ENDS OF GATUN AND MIRAFLORES LOCKS

The upper approach walls of these locks rest on piles and concrete caissons, respectively, sunk to rock through firm earth, which has considerable cohesiveness. On this kind of earth it is feasible to support the crib construction on four rows of piles, driven on 3-ft. centers. The crib will be held stationary, by galvanized steel bolts passing through the piles (Fig. 2). The whole structure will be firm, but resilient, able to "give" to the impact of a vessel, much like the dolphins alongside a dock. When the tops of the piles above the water surface have rotted they will be sawed off and the crib will be built and anchored upon piles wholly submerged.

UPPER AND LOWER ENDS OF PEDRO MIGUEL LOCK

Both center guide walls rest on rock, and this firm base extends in both directions. A reinforced-concrete wall will be built (Fig. 3) following the horizontal projection of the cribbing, to a height of 20 ft. above the canal bottom. The walls will be 18 in. thick, reinforced with square twisted bars of steel. They will be tied together at the corners and at frequent intervals by bars, embedded in concrete cross-walls. The interior of the box will thus be divided into cells, four of which will be rectangular in plan and four triangular.

*Abstract from the "Canal Record" of June 11, 1913.

The cells will be filled with earth, into which piles will be driven to anchor a floating crib.

The crib will move up and down freely with the fluctuations of the water surface. If a crib is struck by a vessel it will transmit the blow to the piles, and the combined structure through its elastic resistance will minimize the damage done to the vessel. When the parts of the piles exposed to air have rotted the piles will be sawed off below the water surface, and cribs will be built and anchored upon them.

The construction of the boxes at the ends of the two approach walls of Pedro Miguel lock, and the concrete wall base at the end of the lower approach wall at Gatun has been completed. Contract has been awarded through the Washington office of the Commission to W. R. Grace & Co. for furnishing 912,000 ft. b.m., of 12x12-in. yellow pine, or Douglas fir lumber. Bids have also been invited on the requisite quantities of drift bolts, anchor bolts, etc., heavily galvanized. Of the lumber, 636,000 ft. will be creosoted, for use where exposed alternately to water and air, and in sea water.

The New York Law Governing Work under Compressed Air

The New York labor law governing the conditions under which labor may be employed under compressed-air pressure has been radically amended by the New York legislature. It is understood that the law as it now stands meets the approval of both the Union of compressed-air workers and the contractors engaged in that class of work. It will be of interest to all responsible for work under compressed air, to see what has been established by law as good practice in New York State. We therefore print the law in full as follows:

Section 134-a. HOURS OF LABOR—All work in the prosecution of which tunnels, caissons or other apparatus or means in which compressed air is employed or used shall be conducted subject to the following restrictions and regulations: When the air pressure in any compartment, caisson, tunnel or place in which men are employed is greater than normal and shall not exceed 21 lb. per sq.in., no employee shall be permitted to work or remain therein more than eight hours in any 24 hours and shall only be permitted to work under such air pressure provided he shall, during said period, return to the open air for an interval of at least 30 consecutive min., which interval his employer shall provide for. When the air pressure in any compartment, caisson, tunnel or place in which men are employed is greater than normal and shall equal 22 lb. and does not exceed 30 lb. per sq.in., no employee shall be permitted to work or remain therein more than 6 hours, suc hfour hours to be divided into two periods of two periods of three hours each with an interval of at least one hour between each such period. When the air pressure in any such compartment, caisson, tunnel or place shall exceed 30 lb. and shall not equal 35 lb. per sq.in., no employees shall be permitted to work or remain therein more than four hours, such four hours to be divided into two period of two hours each, with an interval of at least two hours between each such period. When the air pressure in any such compartment, caisson, tunnel or place shall equal 35 lb. and shall not exceed 40 lb. per sq.in., no such employee shall be permitted to work or remain therein more than three hours in any 24 hurs, such three hours to be divided into periods of not more than one and one-half hours each, with an interval of at least three hours between each such period; when the air pressure in any such compartment, caisson, tunnel or place shall equal 40 lb. and shall not equal 45 lb. per sq.in., no employee shall be permitted to work or remain therein more than two hours in any 24 hours, such two hours to be divided into periods of not more than one hour each; with an interval of at least four hours between each such period; when the air pressure in any such compartment caisson, tunnel or place shall equal 45 lb. per sq.in. and shall not exceed 50 lb. per sq.in,, no employee shall be permitted to work or remain there more than 90 min. in any 24 hours and such 90 min. to be divided into periods of 45 min. each, with an interval of not less than five hours between each such period; no employee shall be permitted to work in any compartment, caisson, tunnel or place where the pressure shall exceed 50 lb. per sq.in., except in case of emergency. No person employed in work in compressed air shall be permitted by his employer or by the person in charge of said work to pass from the place in which the work is being done to atmosphere of normal pressure, without passing through an intermediate lock or stage of decompression, which said decompression shall be, where the work is being done in tunnels, at the rate of three pounds every two minutes unless the pressure shall be over 36 lb., in which event the decompression shall be at the rate of one pound per minute; and which said decompression shall be, where the work is being done in caissons, at the following rates:

Where pressure is not over 10 lb. per sq.in. the time of decompression shall be one minute; when pressure is over 10 lb., but does not exceed 15 lb., the time of decompression shall be two minutes; when pressure is over 15 lb., but does not exceed 20 lb., the time of the decompression shall be five minutes; when pressure is over 20 lb., but does not exceed 25 lb., the time of decompression shall be 10 min.; when pressure is over 25 lb., but does not exceed 30 lb., the time of decompression shall be 12 min.; when pressure is over 30 lb., but does not exceed 36 lb., the time of decompression shall be 15 min.; when pressure is over 36 lb., but does not exceed 40 lb., the time of decompression shall be 20 min.; when pressure is over 40 lb., but does not exceed 50 lb., the time of decompression shall be 25 min.

All necessary instruments shall be attached to all caissons and air locks showing the actual air pressure to which men employed therein are subjected, and which instruments shall be accessible to and in charge of a competent person who shall not be employed more than eight hours in any 24 hours.

Section 134-b. MEDICAL ATTENDANCE AND REGULATIONS—Any person or corporation carrying on any tunnel, caisson or other work in prosecution of which men are employed or permitted to work in compressed air, shall, while such men are so employed, also employ and keep in employment, one or more duly qualified persons to act as medical officer or officers who shall be in attendance at all necessary times while such work is in progress, and whose duty it shall be to administer and strictly enforce the following:

(a) No person shall be permitted to work in compressed air until after he shall have been examined by such medical officer and reported by such officer to the person in charge thereof as found to be qualified, physically, to engage in such work.

(b) In the event of absence from work, by an employee for 10 or more successive days for any cause, he shall not resume work until he shall have been re-examined by the medical officer and his physical condition reported, as hitherto provided, to be such as to permit him to work in compressed air.

(c) No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air.

(d) No person not having previously worked in compressed air shall be permitted during the first 24 hours of his employment to work for longer than one-half a day period as provided in Section 134a; and after so working shall be re-examined and not permitted to work in a place where the pressure is in excess of 15 lb. unless his physical condition be reported by the medical officer, as heretofore provided, to be such as to qualify him for such work.

(e) After a person has been employed continuously in compressed air for a period of three months he shall be re-examined by the medical officer and he shall not be allowed, permitted or compelled to work until such examination has been made and he has been reported, as heretofore provided, as physically qualified to engage in compressed-air work.

(f) The said medical officer shall at all times keep a complete and full record of examinations made by him, which record shall contain dates on which examinations were made and a clear and full description of the person examined, his age and physical condition at the time examined, also the statement as to the time such person has been engaged in like employment.

(g) Properly heated, lighted and ventilated dressing rooms shall be provided for all employees in compressed air, which shall contain lockers and benches and shall be open and accessible to the men during the intermission between shifts. Such rooms shall be provided with baths, with hot- and cold-water service and a proper and sanitary toilet.

(h) A medical lock shall be established and maintained in connection with all work in compressed air when the maximum pressure exceeds 17 lb. as herein provided. Such lock shall be kept properly heated, lighted and ventilated and shall contain proper medical and surgical equipment. Such lock shall be in charge of a certified trained nurse selected by the medical officer, who shall be qualified to render temporary relief.

(i) Whenever in the prosecution of caisson work in which compressed air is employed, the working chamber is less than 10 ft. in length and when such caissons are at any time suspended, or hung, while work is in progress, so that the bot-

tom of the excavation is more than nine feet below the deck of the working chamber, a shield shall be erected in the working chamber for the protection of the workmen.

(j) Whenever in the prosecution of work in which compressed air is employed, a shaft is used, all such shafts shall be provided with a safe, proper and suitable ladder for its entire length.

(k) Wherever in the prosecution of work in tunnels, caissons or other apparatus or means in which compressed air is employed or used, lights other than electric lights are used, the said lights shall at all times be guarded.

(l) All passage ways in work, wherein compressed air is employed or used, shall be kept clear and properly lighted.

A Long-Span Double-Deck Bascule Drawbridge

The accompanying halftones show two views of the recently completed Kaministiquia River drawbridge, carrying the line of the Canadian Pacific Ry. across the river into its new terminal yards and loading docks on Island No. 1, at Fort William, Ont. This structure is of the Strauss trunnion-bascule type and is one of two drawbridges being built for the improvement, the other, not yet completed, being a Scherzer rolling-lift bridge across the McKellar River.

of the reinforcing ordinarily used in these counterweights was omitted.

The total weight of steel in the bridge, exclusive of the approaches, is about 2500 tons. The counterweight weighs about 2400 tons.

The bridge was erected in the open position by means of an erection tower such as is ordinarily used in erecting this kind of a bridge. The placing of the concrete for the counterweight was carried on simultaneously with the erection of the steel, so as to balance the structure at all times.

The movable span is operated by electricity obtained from the Kaministiquia Power Co. It has two 85-hp. motors for raising and lowering, and it is interlocked in such a way that every operation must be performed in sequence and unless the bridge is actually moving up or down, it is held rigidly in position by a brake operated by an independent 5-hp. motor.

The bridge was designed by the Strauss Bascule Bridge Co., Chicago, Ill., under the direction of P. B. Motley, Engineer of Bridges, Canadian Pacific Ry. It was fabricated and erected by the Canada Foundry Co., Ltd., Toronto, Ont.

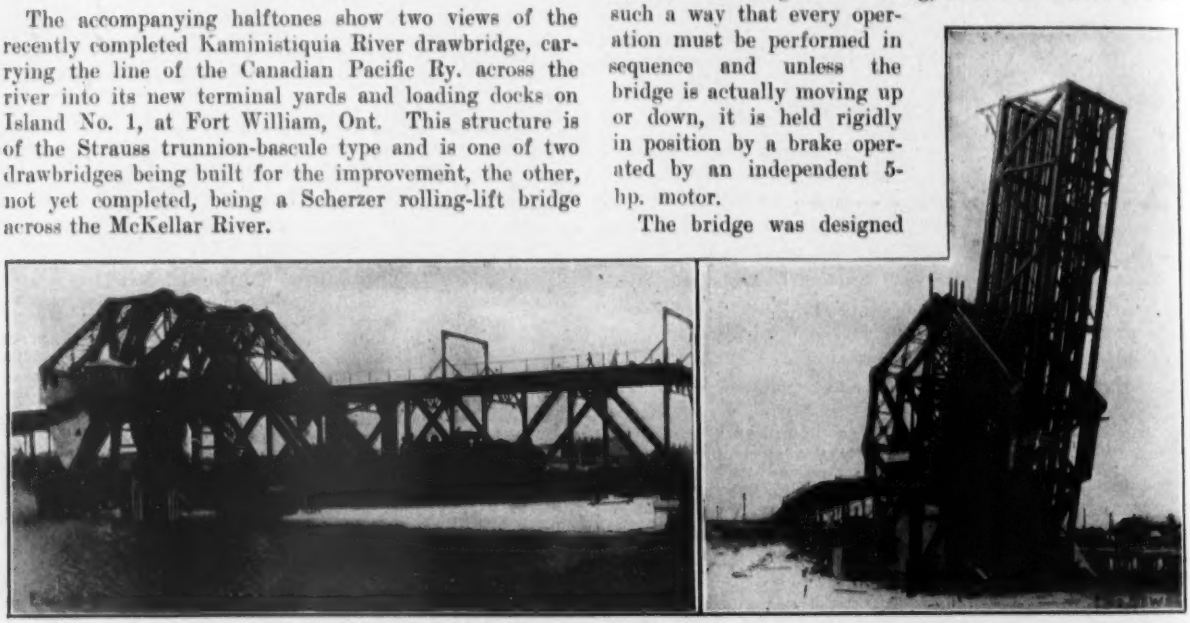


FIG. 1. CLOSED
(River open)

FIG. 2. RAISED
(River closed by ice)

FIGS. 1-2. THE KAMINISTIQUIA RIVER BRIDGE OF THE CANADIAN PACIFIC RY., AT FORT WILLIAM, ONT.

The Kaministiquia River bridge shown is a single-leaf, double-deck bridge with the main trunnions at the point of intersection of the bottom chord and the end post of the truss, that is, of the heel-trunnion type. It embraces a 186-ft. movable span, giving a clear river channel of 180 ft., and a 40-ft. stationary span or tower. The lower deck carries a double-track steam railway and the upper deck a 30-ft. roadway on which are two electric-railway tracks. Long approach viaducts on each side lead the electric railway to the upper deck.

The counterweights are separately mounted on trunnions supported at the top of the tower, and the counterweight trusses, which carry part of the highway floor, are connected to the moving leaf through the counterweight links, which are pin-connected both to the counterweight trusses and the bascule trusses. On account of the size of the structure, the available space for the concrete was small, and it was necessary to make concrete weighing as much per cubic foot as was possible. Iron ore was used in place of stone for this reason, and concrete was obtained weighing about 175 lb. per cu.ft. This concrete had such great tensile strength that most

A Safety Exhibit Car, for the education of the employees, has been put into service in connection with the safety department of the New York Central Lines. Along the sides of the car, which is finished in white enamel, is a shelf about 3 ft. above the floor. Models of the various machines, fitted with the proper gear guards, used in the shops of the system are placed on this shelf for the purpose of showing the requirements of the railroad as regards the protection of its shop employees. Upon the walls are many photographs showing the right (i.e., the safe) and the wrong method of performing many of the daily routine operations of repair, coupling and switching, in the shops or about the yards of a great railroad system. There are other pictures indicating the extent and danger of the trespass evil. A lecture coach will be attached to the exhibit car and illustrated lectures will be given to the employees at various points. It is proposed to make their attendance, at least at some of these lectures, compulsory by presenting them during working hours. It is also the intention to invite public officials, especially judges, to examine the contents of the car in the various towns which it visits so that they may be made more conversant with modern safety methods.

Handling West-Bound Freight on the North River Railroad Piers

By W. J. Barney*

Under present conditions, a team seeking freight at the outer part of a pier is obliged slowly to work its way through piles of freight and waiting teams on the inshore end of the pier; and a team delivering to a bulkhead shed is often in line for hours before obtaining an opening at the limited shed frontage.

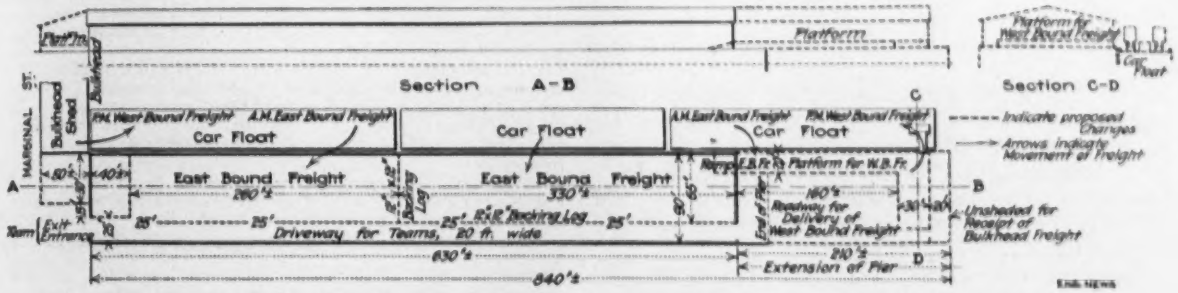
Under the plan here proposed, teams will be afforded clear access to all parts of the pier and the facilities for handling west-bound freight greatly increased without lessening the present working area.

In considering this plan, it should be stated that the piers are divided into two classes: the "A" pier, only one side of which is available for the mooring of car floats, the other side being closed by adjacent ferry racks, or being closed by the terms of the lease from the city, and the "B" pier, both sides of which are available for the mooring of car floats.

car float. Access to these sections from the driveway is provided by entrance ways cut through the backing logs. With this arrangement, teams seeking incoming freight may be readily regulated by directing them from the freight entrance to the proper section, which may be reached without delay.

This plan provides for increasing the bulkhead shed 25 ft. or more across the front of the pier for the handling of west-bound freight. Teams at the marginal street have access to this extended shed both at the front and at the side.

For further handling of west-bound freight, across the outer end of the pier as shown, a second "bulkhead platform" may be constructed, with sufficient roadway in front reached by the through driveway from the head of the pier. This second platform will lessen the cost to the railroad of handling west-bound freight, since with this platform a row of car floats may be loaded from both ends, thus avoiding the long loading haul by hand trucking from the bulkhead. It will also lessen the cost to the shipper by providing more receiving points and thus shortening team delays.



Plan to Relieve Team Congestion in Handling West Bound Freight on the Railroad Piers, North River, New York City

The typical plan here presented shows the proposed arrangement adapted to a pier of class "A." The front team entrance, usually at the center of the shed front, is shifted toward the closed side of the pier. From the entrance, along the closed side of the pier, a driveway 20 ft. wide, extending the entire length of the pier, is reserved for incoming and outgoing teams. This driveway is separated from the freight-storage spaces by 12x 12-in. backing logs. Under the present conditions, a driveway of the same width is, supposedly, kept open along the center of the pier; but in reality it is constantly blocked by teams loading, or by freight carelessly placed. Therefore, a definite driveway marked by backing logs means no loss of proper storage area, but does mean ready control and quicker passage for all teams entering and leaving. If the pier is narrow, less than 70 ft., the strip reserved for the driveway may be offset by widening the pier 15 or 20 ft. along the available side of a class "A" pier or either side of a class "B" pier. This lessening of the slip room would rarely be objectionable, since owing to the limit of the bulkhead lease, or to the particular width of the slip, there are few slips used by car floats which may not be narrowed 15 or 20 ft. before interfering with car-float handling.

The pier, as shown in the drawing, is divided by backing logs into sections about the length of the ordinary

*Consulting Engineer, General Contracting & Engineering Co., 29 Broadway, New York City.

Where competition for through freight is keen, this second platform may be designated for receiving the railroad's local noncompetitive freight. The return platform and ramp shown permits also the handling of east-bound freight at the outer end of the pier.

When a pier is used on both sides for mooring car floats, the 20-ft. driveway may be reserved in the center of the pier, sections for east-bound freight being located on either side and the west-bound platform at the outer end of the pier.

This plan is especially desirable for a pier extension that is not long enough to provide a berth for another car float. Such an extension can be provided and efficiently used to relieve the congestion of west-bound freight, the outer car floats being shifted out to the outer west-bound platform, as the inner floats are shifted to the bulkhead; furthermore, as the teams handling east-bound freight are practically all off the pier by early afternoon, the teams delivering west-bound freight in the late afternoon will have a clear driveway.

Automobile Exports in the Fiscal Year 1913, according to the Department of Commerce, Washington, D. C., aggregated 40 million dollars, against one million in 1903. The number of automobiles exported in 1913 was 25,000, against 3000 in 1907, at an average price for the latter of $1800. The 1913 exports included about 1000 automobiles at an average valuation of $1700 each and 24,000 cars at about $1000 each. The imports of automobiles in the fiscal year 1913 were less than two million dollars' value, against over four million in 1907.

The "Verband Gross-Berlin," a New Form of Metropolitan Government

[EDITORIAL CORRESPONDENCE]

A novel form of organization auxiliary to municipal government was established in Berlin, Germany, about a year ago. Berlin itself is comparatively small in area, and the dozen or fifteen independent communities which are immediately contiguous to the city and belong to the metropolitan community contribute about one-half the total population. The various common interests of these communities are not adequately cared for so long as the governments are entirely separate. The new organization, commonly called the "Zweckverband" (its official name is "Verband Gross-Berlin"), is designed to be the instrument for dealing with the most important matters of joint interest. The Zweckverband was established by act of the Prussian legislature of July 19, 1911, but the law did not go into effect until April 1, 1912.

MAKEUP—The members of the Zweckverband are the cities of Berlin, Charlottenburg, Schöneberg, Rixdorf (Neukölln), Wilmersdorf, Lichtenberg and Spandau; the towns of Steglitz, Gross-Lichterfelde, Friedenau, Cöpenick, Boxhagen-Rummelsburg, Pankow, Weissensee and Reinickendorf, all lying in the townships (Randkreise) Teltow and Niederbarnim; and these two townships themselves for all parts of their areas lying outside the towns named. However, any other town in this territory becomes an independent member of the Zweckverband when its population reaches such a figure as would entitle it to one representative in the Verband Assembly (30,000-40,000).

REPRESENTATION—The Lord Mayor (Erster Bürgermeister) of Berlin and 100 elected representatives form the assembly of the Verband. No single member of the Verband is entitled to more than 40 representatives, but with this exception the representation is divided in proportion to the number of inhabitants. Election is for six years, half the membership being renewed every three years. The community legislatures or councils elect the representatives.

FUNCTIONS—The purposes of the Zweckverband are stated by the organic act to be:

1. Control of the relations of the public to rail transportation (the state railways excepted).
2. Coöperation with the local authorities in city planning, in fixing street widths, etc., and in establishing building laws.
3. Acquisition and maintenance of parks, groves, meadows, lakes, playgrounds and similar open places.

The method of dealing with these purposes is prescribed in some detail, by giving definite powers and authority to the Verband. It is necessary to quote these from the act, in order to describe the nature of the organization.

RAILWAYS

Authority is given the Verband to build or purchase railways, and to operate them or farm out their operation. It has right-of-way in public streets for the purpose, but must pay damages and compensation to the local authorities. It has the power to take over (by purchase) railways belonging to local authorities, without consent of the latter, on 12 months' notice; but, except by agreement, a railway line thus taken over must include all branches or dependent lines belonging to the same local authority, and the existing personnel must be retained.

All rights and obligations of local authorities with respect to private railways are vested in the Verband.

Local authorities may still undertake the construction and operation of new railway lines, upon approval by the Verband Assembly.

BUILDING REGULATION

All functions of city planning may be exercised by the Verband in the case of main thoroughfares and railway streets, and to a limited extent in the case of unimproved parts of the metropolitan area. Where the Verband does not itself take action in these matters, the local authorities may act, subject to the approval of the executive committee of the Verband.

In general, the construction of roads, etc., under plans developed by the Verband must be done by the local authorities, with financial assistance from the Verband where necessary. However, the Verband may, and in some cases must, handle the construction work itself.

When new building laws are formulated by local authorities, or changes made in the existing laws, the executive committee of the Verband may claim the right to be heard in an advisory capacity.

PARKS

The Verband may acquire park areas by purchase, lease, or the acquisition of rights. It may develop and maintain them, or turn over the maintenance to the local authorities (though at the cost of the Verband).

FINANCING

The money required for the work of the Zweckverband may be raised by levying fixed dues on the member communities, by levying deficit assessments, or by way of loan. Dues and assessments may be distributed in proportion to benefits received by the several communities, or in such manner as fixed by the Verband itself. No reference is made in the organic act to population, area or representation, as measures of the proportion of assessment. On the other hand, it is specifically provided that the Verband may take account not only of benefits accruing to individual communities, but also of the extent to which a community may, before creation of the Verband, have promoted the above-stated subjects of joint interest.

The individual community may raise the amount of its assessment either by way of general taxation, or by distributing it on a basis of local benefits or the like.

GOVERNMENT OF THE VERBAND

The government of the Verband comprises the Assembly (composed as described previously), an executive committee, and a director. The Assembly meets at the call of its chairman or on petition of one-third its number, but not less than once a year, and in general its sessions must be public. The executive committee, which has only a minority representation elected by the Assembly and for the rest is made up of specific public officials, has (like the Assembly) a term of office of six years. Its functions are to carry out the resolutions of the Assembly, direct the management of the Verband, and conduct all minor business not requiring action by the Assembly. The director is elected by the Assembly, for a term of six to twelve years, subject to approval by the King of Prussia; in case of failure to elect, the Minister of the Interior may appoint a managing board.

Generally, for all matters of dispute and for all decisions of the Verband Assembly, two appeals are provided, the final appeal lying in most cases to the Ministers of the Interior and of Public Works.

As yet the Zweckverband has done little or no important work, and therefore the ultimate results of the institution cannot be judged. The great need for a means of bringing together the separate municipal interests of Greater Berlin is well recognized, of course, but whether the Zweckverband will meet this need will depend wholly on the work it does.

The first annual report of the Verband is expected to appear in a month or two. This may give a basis for predicting the future of Berlin's "County Council."

F. E. S.

An Iron Removal Plant for the Water-Supply of Centerburg, Ohio, was one of two conditions imposed by the Ohio State Board of Health in approving plans for a proposed water-supply for that place on June 26, 1913. The other condition was that the local council pass an ordinance providing for the protection of the source of supply. The works must be installed before Sept. 1, 1914.

EDITORIALS

The Governor of Missouri as Grand Pathmaster

The latest effervescent stage of the good roads campaign hails from Missouri. The governor of that state, according to the St. Louis "Republic," has called on "all able-bodied Missourians to turn out and help improve Missouri roads on Aug. 20 and 21." It was not so very many years ago that much the same sort of call was issued yearly by "pathmasters" or "highway surveyors" between "hoeing and haying" or at some other season when farm work was slack in almost innumerable "road districts." These calls to "work out the road tax" brought out young and old, the halt, the lame and the blind and resulted in a rare exchange of local gossip and the scraping of more or less mud and sod from the ditches to the middle of the road—to be washed back into the gutters at the first heavy rainstorm.

In making himself a grand or state "pathmaster" the governor of Missouri may arouse considerable enthusiasm for highway improvement, but unless he or someone else utilizes that enthusiasm to better purpose than was shown in the old-fashioned district road repair the mud in the Missouri roads will again be hub deep by autumn or early winter—when improved roads are most needed.

The "Republic" urges that since a large percentage of the population of Missouri lives in St. Louis and other cities of the state and by virtue of their distance from country roads and their lack of muscle and skill will be unable to help much by personal physical work, all such persons should aid the common cause of good roads between country and city by cash contributions. Accordingly the journal named has opened subscriptions throughout the state.

We venture to suggest that a part of the fund so raised be employed to pay experienced engineers to direct improvement work in Missouri—not only on Aug. 20 and 21 but also during the months to come. Some of the money might also well be spent in a state-wide educational campaign. Good roads will not come from two days of making the dirt fly, even if it be repeated each midsummer; but such occasions may be utilized to awaken interest and to promote an intelligent understanding of the essentials of road engineering and economics.

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Premature Engineering Competitions

Some months ago we devoted considerable editorial attention to a competition inaugurated by the city of Richmond, Va., for the design of a bridge across the James River, the awards for which have just been made as announced on another page. Among the many things which were at fault in this competition was the fact, unknown to the competitors generally, that there was only a remote possibility that the bridge would be built in the immediate future. As an instance of the undesirability of calling for competitive plans on a bridge or other structure whose erection is a matter of doubt, or at least is subject to the vagaries of legislative bodies, we note a letter just sent to Secretary of the Treasury McAdoo and transmitted by him to Congress. This letter is signed by the members of the commission which has in charge the erection of a memorial bridge across the Potomac River at Washington connecting Potomac Park with the National Cemetery at Arlington, and reads as follows:

> The last public buildings bill provided a commission for the purpose of investigating and reporting to Congress a suitable design for a memorial bridge acoss the Potomac River, and authorized the commission to spend $35,000 in procuring such a design. We, the undersigned members of the commission, respectfully request that you ask Congress to appropriate this amount, including it in the deficiency bill so that this work may be started.

Looking back over the files of ENGINEERING NEWS we find in the first half of 1900 that four eminent engineers, George S. Morison, L. L. Buck, W. H. Burr and W. R. Hutton, were asked by a Federal commission to submit designs for a memorial bridge across the Potomac River to connect Potomac Park with the National Cemetery at Arlington. As a result of this request these gentlemen submitted designs, and in June of 1900 Prof. Burr was awarded a first prize of $1200, and Messrs. Hutton, Buck and Morison were awarded the second, third and fourth prizes of $1100, $1000, and $900, respectively.

While there would seem to be no inherent reason why the general features of a bridge designed 13 years ago would not be suitable today, especially when the designer is still practicing and available to make the minor changes required by the progress of the art, it is evident that the present commission is not willing to trust the engineering judgment or artistic taste of its predecessors. Consequently, the labor of the original competitors is a dead loss, both to the profession and to the government.

The Richmond authorities explained that they wanted to have an accepted design on hand so that they could start work whenever the opportunity presented. The Washington experience should teach them that in public matters the conception of an idea is often far distant from its realization.

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Lessons from a Probable Water Cress Typhoid Outbreak

A typhoid outbreak of unusual character and uncommon interest is reported elsewhere in this issue. While the evidence was not all in when Mr. Vogelson sent us the data which we publish, the conclusion seems to be warranted that water cress was the route or vehicle of infection.

The incident illustrates both the searching epidemiological work now being done by health departments, and the unsuspected and absolutely unprotected possible routes of typhoid infection which exist in every city and town of the country. It also illustrates the general carelessness and thoughtlessness of purveyors and handlers

of food; including those responsible for its appearance upon the very tables where it is to be consumed by themselves and their families. Even the housewife who is most particular about the cleanliness of all food-handling operations within the four walls of her own house, generally accepts without question as to previous history, fruits and vegetables which are to be eaten uncooked, and seldom gives more than a casual thought to the sanitary quality of the milk, cream and ice cream which she buys to place upon her table.

Even should further investigation prove that the water cress served at the Philadelphia wedding breakfast was not responsible for the typhoid that followed (and we look for no such proof) the incident is scarcely the less a warning of the possible dangers from this and similar food supplies which are rarely subjected to efficient public-health supervision. By no means all typhoid outbreaks due to polluted watercress, oysters, etc., come to light. Moreover, there is reason to believe that the number of scattering cases due to these causes far exceeds in their total the number of cases that are recognized and recorded in time of marked outbreaks. It is such marked outbreaks and scattered cases of food infection which, combined with secondary cases and with cases developing in unknown numbers from carriers, make up a large percentage of the typhoid which was once ascribed to water-supplies alone.

Venturing now a word of comment on the Philadelphia outbreak. The data at hand seem to indicate a fresh infection of the watercress shortly before it was eaten. This might readily have occurred at the beds. The bulk of the infection might have been concentrated on a small area, and then the cress from that area might have been gathered, bunched, and all or nearly all of it have gone to the wedding breakfast.

What can be done to guard against such typhoid outbreaks as followed the Philadelphia wedding breakfast? Probably the answer which would first spring to lips of 99 of 100 intelligent persons taken at random would be, *all* such food supplies should be protected by board-of-health inspection of the endangered foods. We shall not take the space now to show how far beyond the funds and organization of boards of health such an immense and diversified task would be. Instead we suggest (1) that under present conditions of public-health work, a given sum of money would accomplish ten to a hundred fold as much if expended on controlling what Dr. H. W. Hill forcibly calls *sources* rather than *routes* of infection; and (2) that those responsible for supplying domestic and public tables with food should realize that they have a duty to perform for their families and guests in the way of properly cleansing and, if need be, disinfecting all uncooked foods liable to spread typhoid fever or other communicable diseases.

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Bonus Systems for Purchasing Cement

In all commercial transactions the principle of paying for quality as well as for quantity is well established, but payment *in proportion* to quality is strictly adhered to in only a few. In the purchase of engineering materials—and particularly structural materials—the excess quality over a certain established minimum requirement is rarely considered of sufficient value to the purchaser to warrant additional payment, which naturally does not tend to improve the quality of the product beyond certain limits.

Several times in the past this undesirable condition in the cement field has been recognized by proposition of bonus systems of one sort or another, in which a fixed price is asked on a cement passing the standard specification with a bonus in proportion to certain arbitrary increases in test or composition.

Such systems have never had any success, mainly because of the extreme difficulty in establishing a comprehensive gage of quality. By agreement certain fixed standards have been accepted for portland cement, and a cement to be satisfactory must be at least as good as the standard in each of several qualities. No cement can be made that will maintain precisely these minimum requirements, but in the present state of the art it seems impossible to grade the preponderance of the respective qualities.

Bonus systems have been proposed in which an extra price should be paid for excess tensile strength at seven or 28 days, but it was soon found that certain flash cements brought a large price under such a system, although at the end of a year they were inferior in strength to a slower setting product. A later bonus scheme was based on an added price for extra fineness, but it has been shown that fineness alone is not always a measure of strength. These schemes have all proved impracticable on account of the difficulty in measuring the superiority of a cement.

On another page of this issue we present the outlines of a bonus system, proposed by W. C. Reibling, of the Philippine Bureau of Science, which aims to avoid the possibility of doctoring a cement to qualify highly, by providing bonuses for increase in several different qualities, all of which must be simultaneously high to produce a superior cement.

Insofar as it avoids the undesirable emphasis of one quality, Mr. Reibling's method seems to be very good, but the proposal does not overcome the one fatal objection to bonus purchasing of cement; that is, its dependence on tests which can not be performed by different persons without considerable variation in results. It is well known that the personal equation in testing cement is very large and that no two laboratories can obtain accordant results. While the minimum requirements of the present standard specifications are far enough below the behavior of most cement to allow for the apparently unavoidable drops below the average, it would be extremely unsafe to pay for proportional superiority to the minimum as indicated by the current tests, unless both buyer and seller are willing to assume that the variations each way in the long run will balance each other for any one particular seller. Mr. Reibling avoids the difficulties surrounding a proportionate bonus system, but his payment is still dependent on testers' reports, which are so variable as to promise trouble between buyer and seller.

After all, the fault with any bonus system for cement selling lies in the ignorance of the relation between the test and the performance. It is apt to be forgotten, particularly by those who are continually testing cement, that tests are only the faintest simulation of working conditions. What the builder wants is a concrete that is strong and durable. Presumably he is willing to pay for a cement in proportion as that cement will produce a

strong and durable concrete, but while it may be reasonably assumed that the standard tests are indications of the probable behavior of concrete, it is extremely venturesome to assume that structural behavior is directly related to miniature tests and to pay for the material according to that relation. At least, it will be venturesome until we know more about the nature of cement and can prescribe methods of testing that will bring about more concordant results.

The City Manager Plan Again

In our issue of Mar. 13, 1913, we commented upon the City Manager plan. Some of our remarks have brought out such lively criticism from Richard S. Childs, secretary of the National Short Ballot Organization that it seems advisable to print his letter in this place and in replying to it extend somewhat our earlier discussion of the city manager movement, which is gaining public attention at as rapid rate as did the Commission plan during its earlier years. Mr. Childs writes:

It seems to me that in two important respects you have misunderstood the theory involved when you describe it as a "reversion to or adoption of the one distinguishing feature of the federal plan." To be sure, the City Manager plan does separate the representative and legislative functions from the executive function, but it separates them in a very different and much better way than the federal plan does. In the federal plan you have two governments, the Mayor being one and the Council the other. They are somewhat loosely connected, but the opportunities for pulling and hauling between the two powers is enormous and greatly impairs the efficiency of the government. Frequently, the Council and Mayor will be at open war. One New Jersey city recently was in a state of complete deadlock because the Council would not confirm the Mayor's appointments and the offices were empty and work at a standstill for months. The Council appropriates money, but has no power to make the Mayor spend it efficiently and economically. The Mayor is responsible for cleaning streets and good pavements, etc., but lacks the one power which it needs most of all if he is to deliver the goods, i.e., the power to get the necessary money. Often a Council will hold up the Mayor until he concedes control of patronage to Council members, and an interchange of power occurs, with the Council trafficking in patronage and the Mayor, in return for his acquiescence, securing a free hand in matters of policy. The federal plan is a ramshackle and only works well when there is a harmonious and mutual forbearance on the part of its two heads.

In the City Manager plan, the Council in fact constitutes the whole government and hires its own agent or City Manager to carry out its decrees. Such a manager has no authority to differ with the Council. If the Council is corrupt, he too must be corrupt or risk the loss of his job. If he is corrupt, the Council which hired him and is free to discharge him takes the responsibility. The Council can blame no one but itself if it fails to hire a satisfactory City Manager and get results.

It is a single-headed government, where the federal plan is two-headed. The plans are as different as black and white and the City Manager plan cannot fairly be called any relative of the federal plan.

You say "to be successful, the Manager . . . . must be absolutely free of all control by the City Council or Commission except that inhering in the power for removal for cause." On the contrary, the Manager can be fired by the Council at will and has no protection whatever from the Council, it being the object of the plan to give him no degree of independence whatever, but to make the Council accept responsibility for everything. The Council is not to be allowed any such excuse as that the Manager is an unsympathetic servant. The only protection he has against discharge is the danger that the Council will have difficulty in getting good results with a novice in his place.

We were discussing the City Manager plan in its broader aspects and not merely as a modification of the Commission plan—which modification is in itself a confession of one of the most serious weaknesses of the Commission plan and a partial return to the federal plan, or to the separation of executive from legislative functions.

Mr. Childs does not present the federal plan at its best, particularly in what he says about Councilmanic holdups of appointments by the Mayor. In the simon pure federal plan of city government the Council has nothing to say about appointments, the Mayor having the sole appointing power. True, under the federal plan the Council controls the purse strings, but only in the matter of the amount of the appropriations, and not at all as regards the spending of the money—which separation is one of the fundamental objects of the federal plan. Under the federal plan the Council is not charged with maintaining economy and efficiency in city administration. Its responsibility ceases when it discharges its representative function of determining for the people what policies shall be adopted and in providing money for the execution of those policies. With the spending of the money the responsibility of the Mayor and his executive family begins. The Mayor being elected by the people, solely for executive work, his responsibility is to the electorate and to it alone. This may be two-headed government (if a City Council or a Commission, even of only five men, can be called a head), but each head has clear-cut duties and each is responsible to the electorate for the proper discharge of its duties. Whether such a division of responsibility is or is not desirable involves the whole great question of federal, mixed and commission types of government, with any one of which the City Manager plan may be combined, but with a greater or lesser tendency to convert either of the two last named into the federal plan, with the City Manager as an entire or partial substitute for the Mayor in all save ornamental functions.

As to the last paragraph of Mr. Childs' letter, we admit that we overlooked the fact that the City Managers thus far appointed appear to be mere creatures of the City Councils, subject to their direction and removable at their will.

The City Manager plan is so new and is being tried as yet in such small places only, that we must wait some time before learning whether a City Manager, who is merely the head of the City Council, subject to discharge at the end of any day's work, is any material improvement as chief executive over a Mayor who is also subject to councilmanic control but not to discharge by the Council. The chief hope for improvement under a City Manager who "has no degree of independence" of the Council, as Mr. Childs advocates, is that since he is selected for a big job he will be chosen because he is a big and a fit man, and that a City Council will use better judgment in the selection than would the whole electorate. But there is no guarantee of this.

Our own idea of the City Manager plan is that it should follow in large measure the German plan of virtual selection of a Mayor for life. Perhaps we went too far in urging absolute independence of the Council except as regards removal for cause, but experience teaches that in no other way can most cities of the United States secure that permanency in office which is essential for the efficient execution of municipal work.

Mr. Childs' conception of a City Manager makes him first, last and always a political officer. Our conception is that he should be placed beyond the influence of political changes, chosen for fitness only, under a well con-

ceived mandatory charter provision to that effect, and remain in office so long as he does his work ably, honestly and efficiently.

If there is a good reason for making a City Manager a politically-controlled officer instead of an independent administrative head, then there is all the stronger reason for placing the various administrative subheads, particularly those calling for engineers, under rigid but rational civil service rules. This, however, is a point which was not raised by Mr. Childs.

Concerning the Railways of Sixty Years Ago

As our readers know, the Interstate Commerce Commission is about to undertake the valuation of the railways of the United States, and under the plans laid down in the statute enacted by Congress (the drafting of which is generally credited to Senator LaFollette) the engineers who undertake this work are required to ascertain the original cost of construction of each line of railway.

We doubt not that many of the members of Congress whose votes made this measure a law, believe that the cost of the original construction of a railway represents a large part of its value at the present day. This is true of the railways which have been constructed within the past decade; but when one harks back to the early days of the railway era, from the beginning of railway construction in 1825 down to the resumption of railway construction work after the Civil War in the early '70's, he finds that the railway originally built has very little relation to the railway which is now operating over the same right-of-way.

We doubt if engineers even, especially those of the younger generation, realize what toy affairs the railways built during the first half century of the railway era were compared with those of the present day.

We have recently received from Mr. C. D. Purdon, Chief Engineer of the St. Louis Southwestern Ry. Co., some interesting extracts of an official report on proposed transcontinental railways made to the United States Senate in 1855. The report referred to was a huge affair, printed in thirteen large volumes. One notable feature is the memoranda on railways which it contains, which were prepared by George B. McClellan, Lieutenant-of-Engineers and Brevet-Captain, U. S. A., addressed to Hon. Jefferson Davis, Secretary of War. Only seven years later these two men were the chief figures in the great civil conflict, the one as President of the Confederacy, the other as head of the Army of the Potomac.

The following extracts from Lieut. McClellan's report give a very fair idea of railway practice at that day:

Locomotives weigh from 12 tons to 30 tons, generally from 20 to 24 tons. They cost from $5000 to $8500, freight engines being rather more expensive than passenger engines. This includes the cost of an ordinary eight-wheel tender. Baggage cars generally weigh 16,000 lb., and cost $1200. Passenger cars for 50 passengers weigh 12,000 lb., and cost $2000. Passenger cars for 75 passengers weigh 14,000 lb. and cost $2500. Freight cars on eight wheels weigh 14,000 lb. and cost $650, and are about eight tons to ten tons capacity.

On the New England roads the average cost of the transportation of freight is 1½c. per ton per mile. The transportation of passengers costs about 1½c. each per mile. This is the average of the actual running cost, and does not cover depreciation of the road; to provide for this, and to secure a fair profit, it is generally stated that the freights and fares charged must be double the amounts given above.

In Massachusetts the average cost of repairing locomotives is 6½c. per mile run; for repairing tracks, exclusive of iron renewals, 11½c. The average durability of iron in Massachusetts is not more than ten years. Old rails are rerolled at a cost of $25 per ton; the ends may be rewelded for $5 per ton. In this connection it may be remarked that the ends of the rails first give way, as a general rule; they are repaired by cutting off the injured part of the upper flange and welding on a piece of "Swedes" bar iron. Small injuries in the middle part of the rail may be repaired economically in the same manner.

Rails are now rolled from 18 to 23 ft. in length; on the New England roads they average 60 lb. per yd.; 90 lb. per yd. is recommended by many engineers as the proper weight for the Pacific Ry.

To Lay the Rails—The roadbed being prepared, crossties placed and iron distributed, a party of six men will lay half a mile of track per day.

A cast-iron wheel of the ordinary size will safely bear a weight of 1½ tons.

The railway wooden-truss bridges cost from $30 to $35 per running foot. Two hundred feet has been found to be about the maximum length that a span can safely have; many engineers prefer reducing the spans to 50 ft. Iron bridges have been successfully and economically used on some railways, and cost about $40 per foot.

AVERAGE COST OF SIX RAILWAYS

Massachusetts Western	155¼ miles	53 double tracked
Boston & Lowell	20 miles	all double tracked
Boston & Maine	74 miles	46¼ double tracked
Boston & Providence	43¼ miles	15¼ double tracked
Vermont Central	124 miles	none double tracked
New York Northern	118 miles	none double tracked
Graduation and masonry per mile		$17,343.00
Wooden bridges, per running foot		31.90
Iron bridges, per running foot		40.00
Superstructure, including iron, per mile, single track		8,042.50
Engineering, per mile, main track		1,411.60
Total cost per mile main road in complete running order		62,561.00
Total cost of main road per mile, exclusive of land drainage, stations, etc.		46,619.00

The first notable thing in the above extract is the very light weight of the cars and locomotives then used. With the wrought-iron rails then in use, the running of heavier rolling stock would have been impossible. In fact, the great economic importance of the bessemer steel rail was not merely the reduction which it made in the cost of track construction and maintenance, but the enormous increase which it made possible in the weight of rolling stock.

Even with the very light weight rolling stock, it will be seen from the above extract that the life of the iron rails was very short and the track must always have been in poor condition, judged by present-day standards. It will be noticed that the railways whose average cost is given in the table above, are located in New England where the rough topography made the cost of grading heavy. When railway construction became active on the plains and prairies of the Central West, the cost of grading per mile was brought down to astonishingly low figures.

This is well brought out in another quotation from the above-mentioned report, containing an estimate by Chas. H. Poole, Chief Engineer of the San Diego & Gila Southern Pacific & Atlantic R.R. Co., of the cost of building the projected road. We reprint this estimate as follows:

Two estimates are given, assuming for the purpose of this estimate, that the route is about equally divided into two classes of cheap and expensive work, though the cheaper is largely in excess. We have 10 at the western and 85 miles at the eastern end to be estimated at the lower rate.

The probable average cost of a single mile of this class, at present prices in California, will be for graduation, bridging, and masonry.

10,000 cu.yd. earthwork @ 30c.	$3000.00
10 lin.ft. bridging @ $15	150.00
Culverts and drains	30.00
Cost of graduation, bridges, etc., for one mile	$3180.00

The probable cost of a single mile of the more expensive part will be for the same

20,000 cu.yd. earthwork @ 30c	$15,000.00
10,000 cu.yd. rock excavation @ $3.00	30,000.00
500 cu.yd. masonry @ $10	5,000.00
10 ft. trestle bridging @ $40	400.00
15 ft. trestle bridging @ $20	300.00
300 ft. drains and small culverts	300.00
Grubbing and clearing	200.00
Cost of graduation, bridging and masonry, one mile	$51,200.00
Estimated cost of track per mile	
2000 oak ties @ 80c	$1600.00
90 tons iron rails (60 lb.) chairs and spikes @ $80	7200.00
Transporting material, track laying, etc	1000.00
Cost of one mile	$9800.00
The cost of the equipment of the whole road complete, will be	
10 locomotives and tenders @ $8000	$80,000.00
24 passenger cars @ $2500	60,000.00
6 baggage cars @ $1200	7200.00
20 cattle cars @ $600	12,000.00
40 freight cars @ $800	32,000.00
15 gravel cars @ $500	7500.00
10 hand cars @ $100	1000.00
Total	$199,700.00
Buildings and Fixtures	
Two freight and passenger depots at termini	$30,000.00
Three engine houses @ $8000	24,000.00
Three turntables @ $3000	9,000.00
Six way stations @ $1000	6,000.00
One machine shop	20,000.00
Five artesian wells on deserts @ $4400	22,000.00
Cost of buildings and fixtures	$111,000.00
Cost per mile of cheaper half—graduation, etc.	$3,180.00
Superstructure	9,800.00
Equipment per mile	1,635.00
Total cost of cheaper half—per mile	$14,615.00
Number of miles	95
Whole cost of cheaper half	$1,388,425.00
Cost per mile of expensive half, graduation, etc	$51,200.00
For transportation, add 25% to track	12,250.00
Equipment	1,635.00
Total cost per mile of expensive half	$65,085.00
Number of miles	95
Whole cost of expensive half	$6,183,075.00
Whole cost per mile of cheaper half	$14,615
Whole cost of cheaper half	1,388,425.00
Whole cost of road in working order	$7,571,500.00

The duty on rails being 30%, the cost of the track would be materially reduced by an omission of that charge, making a saving of about $1000 per mile, and reducing the cost of the road as estimated to $38,840 per mile.

Mr. Poole's estimate of $3180 per mile as a fair cost for grading a roadbed ready for laying track is probably not far out of the way for a very considerable mileage of railway built on the Western plains and prairies during the 30 years from 1850 to 1880. It will be seen that the rails were the most expensive item in the railway construction of that day, costing $80 per ton. The unit prices for earthwork and rock excavation appear high, but it must be remembered that all this work had to be done by hand labor and that high wages were common on the Western frontier, that hand drilling and black powder were the sole means for blasting rock, and that modern earth-handling machinery had not been invented. The small volume of traffic the road was expected to carry is perhaps best indicated by the fact that 40 freight cars were supposed to be sufficient for a road nearly 200 miles in length.

It appears to us that these figures of the cost of old-time railway construction are pertinent at this time when engineers have been directed by the Congress of the United States to ascertain the original cost of constructing the railways within its borders.

Suppose it were possible to find exactly how much one of the railway companies of 50 or 60 years ago paid out in cash for the construction of its road. Is it not obvious to anyone that those figures have very little relation to the cost represented by the railway as it exists today? The railway valuation act specifically requires that the Commission shall ascertain "the original cost to date of each piece of property owned by a common carrier." No law, however, can compel the Commission to perform impossibilities. So far as most of the railways built prior to 1870, or even 1880, are concerned, the data have long ago disappeared which would have enabled the actual cost of construction to have been ascertained.

Admitting the possibility that the engineers can measure and compute the cubic yards of excavation and embankment, what unit price shall they apply to it to determine the "original" cost? The prices at which the work could be done at the present day are certainly not the original cost, so where is the line to be drawn between the cost of performing the work in those days of hand shovels and hand drills and the actual amount which may have been paid over by the railway company, perhaps to a construction company which may have made a profit of 100 or 200% on the one hand, and on the other hand very likely had to take its pay in the railway companies' securities at par and dispose of them at a large sacrifice in order to raise money.

In our comment on the railway valuation act at the time it was passed, we expressed the opinion that the attempt to unearth the past history of railway enterprises was an attempt to accomplish the impossible; and that even if it could be accomplished, it could lead to no useful results. It is unfortunate that Congress in drafting the valuation act did not seek the aid of expert advice, so that the law might have been framed in a more workable manner. Under the present conditions, the Board of Engineers in charge of this work has some exceedingly knotty problems to solve.

Turning again to these old-time figures of railway cost, it is a pity that they are not more generally known to the public. There is a widespread belief, even among intelligent people, that the railway capital of the present day is largely composed of water. The basis for their belief is, without doubt, the work which was commonly done 25 to 40 years ago in cheap railway construction, where the entire cost of the road was paid by the proceeds of bond issues and the stocks represented merely the hope of future earnings. As has been many times shown, most of that old stock has been wiped out by processes of reorganization.

The most important thing, however, in the above quotation from this old-time report to Jefferson Davis is the evidence it gives that the railway which was then built was, as we have said above, a mere toy compared with the railway of the present day.

The rails and the ties have been worn out and replaced again and again. The original rolling stock long ago went to the scrap heap as have several generations of its successors. The roadbed itself has been widened and strengthened; masonry arches have taken the place of wooden culverts; heavy steel and concrete bridges have replaced the flimsy wooden structures originally constructed, and in the case of many roads, more millions of money have been expended on freight and passenger terminals than the entire original expenditure in building the railway itself. What was originally expended to build these roads, therefore, is of historical interest merely and sheds no light on their values at the present day. For any fair and useful valuation of our railway systems we must deal with present-day conditions, and it is useless to delve into past history.

LETTERS TO THE EDITOR

A Suggested Simplification for the Value of C in Kutter's Formula and a Sewer Discharge Diagram

Sir—Almost everyone who has had occasion to use Kutter's formula has felt that some simpler expression might be devised to serve the same purpose. Some time ago I noticed a German abbreviation of Kutter's formula, quoted by Emil Kuichling in a review in ENGINEERING NEWS, Mar. 13, 1913, p. 541. This suggested to me that a purely factorial form for C, sufficiently accurate for ordinary purposes, might be derived. The following modification may not be original, but I do not recall having seen it. I suggest expressing C in the Kutter formula (for use in sewer work, $N = 0.0135$), thus:

$$C = 117\, R^{0.26}$$

As is well known, C varies slowly for changes in S or the slope, so S does not enter in this equation. To compare the values of C computed by three different formulas, I give the following table showing the coefficient for sewer pipe varying from 4 to 36 in. in diameter

COEFFICIENT C IN THE FORMULA $V = C\sqrt{RS}$, COMPUTED BY THREE FORMULAS

$$\text{I} \ldots\ldots C = \frac{41.6 + \frac{0.00281}{S} + \frac{1.811}{N}}{1 + \left(41.6 + \frac{0.00281}{S}\right)\frac{N}{\sqrt{R}}} \quad \text{Kutter Formula}$$

$$\text{II} \ldots\ldots C = \frac{178.56\sqrt{R}}{0.000 + \sqrt{R}} \quad \text{German-French Formula}$$

$$\text{III} \ldots\ldots C = 117\, R^{0.26}$$

Diam. of pipe, in.	I	II	III
4	59.5	58.0	61.3
6	67.8	66.3	68.1
8	73.7	72.6	73.4
10	78.5	77.1	77.8
12	82.6	81.2	81.6
15	87.4	86.1	86.5
18	91.6	90.2	90.7
20	93.8	92.5	93.2
22	95.8	94.6	95.5
24	97.6	96.7	97.7
30	102.5	101.5	103.5
33	104.5	103.6	106.1
36	106.3	105.5	108.6

The value of N in Kutter's formula was taken as 0.0135, and S in Formula I was assumed to have a mean value of 0.01. The results by all of these formulas agree very closely. The values obtained by Formula III for the smaller pipes are slightly larger than those by the Kutter formula. This is desirable, since it is generally conceded that Kutter's formula gives results that are too small for the pipes of small size. Another advantage in this type of formula is that it may be incorporated directly in the formulas $Q = AV$, and $V = C\sqrt{RS}$, so as to express the discharge as a simple factorial formula involving three variables, thus:

$$Q = 32.04\, D^{2.76} S^{0.5}$$

Changing this formula so as to express the diameter in inches instead of feet, we have

$$Q = 0.03366\, D^{2.76} S^{0.5}$$

in which

Q = Discharge of sewer, flowing full, in cubic feet per second;
D = Diameter of pipe in inches;
S = Slope.

This formula is to be used only for a value of the roughness factor, $N = 0.0135$. A formula such as the one above permits of easy representation by means of logarithmic diagrams. The accompanying diagram is similar to the one given by Turneaure and Russell, for computing the flow in pipes under pressure, and is used in the same way. That is, three simultaneous values of

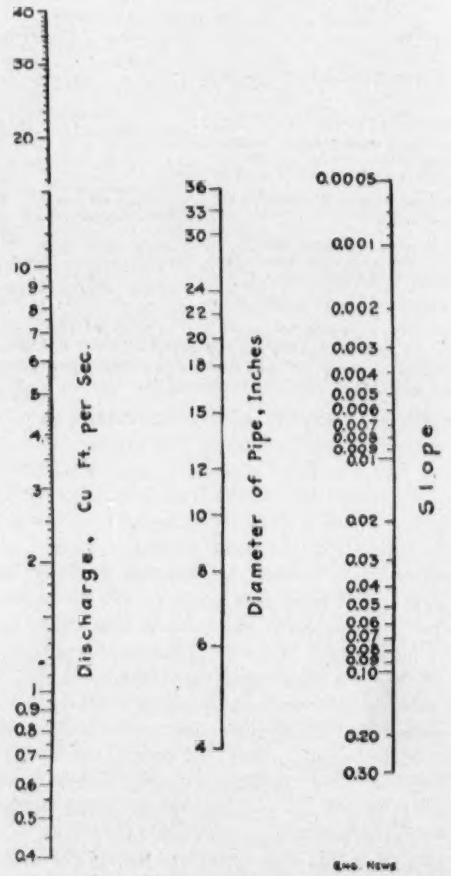

DIAGRAM FOR DETERMINING SEWER DISCHARGE
[Devised by Alfred Boyd.]

the variables Q, D and S are obtained by laying a straight-edge across the three parallel axes and noting the intersections.

ALFRED BOYD.
Oklahoma Agricultural and Mechanical College.
Stillwater, Okla., June 27, 1913.

The Effect of Stable Refuse on Concrete

Sir—The accompanying views show the interior of a reinforced-concrete building located in Kansas City, Mo., and used as a stable for a transfer company. The ground floor was used for the handling of freight, the second floor as a stable for the horses.

The building was completed in November, 1908, and about two years afterward began to show signs of failure in the second-floor structure immediately below the stalls. The cracking and sagging of the floor and girders continued until the owner was obliged to spend about $1800 in cutting out old and putting in new concrete.

To recover this $1800 he brought, against the builders and their bonding company a joint suit which came to trial last March. It developed many points of interest to designers and builders of similar concrete structures.

First of all, it was shown that the architect employed by the owner submitted general plans only, giving the location of the columns, length of spans, working floor loads, and test loads to be applied on completion; and

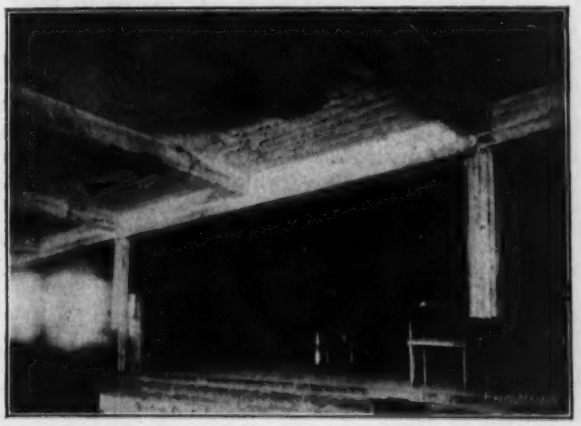

FIG. 1. UNDER SIDE OF STABLE FLOOR, SHOWING DARK SPOTS CAUSED BY PERCOLATION OF STALL DRAINAGE

invited the bidders on construction to submit their own detail plans of the floor and its reinforcing, these to be approved or rejected along with their bids. Although he testified that he was not supposed to act as "clerk of the works," he nevertheless O.K.'d the building engineer's detail plans before the work started, and accepted the building as satisfactory after the test loads had been applied without sign of failure.

The chief contention throughout the trial was, on the owner's side, that the failure was due to faulty construction, and, on the builder's side, that it was due to the disintegration of concrete by refuse from the stalls.

Hans Von Unwerth was retained as engineer witness by the owner; and, after careful examinations, testified that, in at least one instance, the reinforcing bars had not been accurately placed.

Against this fact, however, was the other fact that the tests had been applied without causing failures. Furthermore, witnesses on the builder's side testified that although the construction of the entire floor was the same, failures had occurred only where refuse from the stalls had lain upon it. The writer was retained as engineer witness by the builder to describe the disintegrating action of manure on concrete. It was shown that the horses, standing on the bare concrete floor, had kicked holes in the top finish with their sharp calks and these holes had retained the drainage so that it percolated through the floor instead of draining off through the gutters.

The jury accepted the builder's contention and decided against the owner, who did not appeal the case.

The whole affair illustrated the advisability

(1) Of having one designer responsible for all plans and details of a reinforced-concrete building.

(2) Of providing (in the case of a concrete stable) ample floor pitches to carry away stall drainage.

(3) Of constructing perfectly water-tight floors if possible.

(4) Of adding an extra safety area on top of all beams and girders to insure that the disintegration of their tops does not reduce the compression area to a dangerous degree.

(5) Of protecting all stall floors with wood or other material against the wear of sharp-shod horses.

BENJAMIN BROOKS.

4241 Holmes St., Kansas City, Mo.
July 28, 1913.

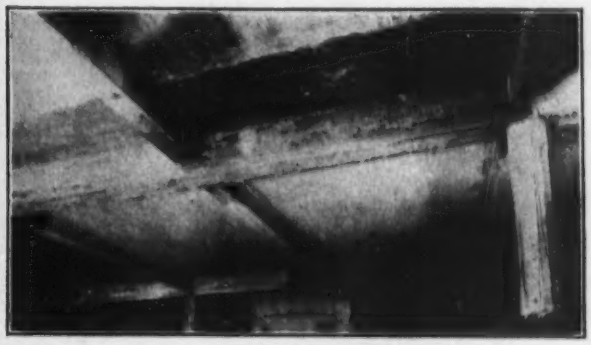

FIG. 2. UNDER SIDE OF STABLE FLOOR
(Dark area shows position and extent of new concrete)

Experiments on Sludge Digestion at Lawrence, Mass., and London, England

Sir—Due to absence an article in your issue of July 3 escaped my notice until today. For the sake of historical correctness it may be well to add a few words thereto. It is the article of H. W. Clark and G. O. Adams, headed "Studies at the Lawrence Experiment Station upon the Disposal of Sewage Sludge in Deep Tanks."

The communication begins with:

> The first suggestion in regard to the retention of sludge in compartments separated from the main settling or septic tank, was made at the Lawrence Experiment Station in 1899, and tanks constructed after this matter were operated there in that and the following years and have been described in the Lawrence reports.

When I was studying the London sewage disposal investigations and works in 1880, under the guidance of Sir Jos. W. Bazalgette, Chief Engineer of the Metropolitan Board of Works, and when again studying the same in 1891, when I met, besides the engineers, the chemists of the London County Council, among whom was W. J. Dibdin, I posted myself regarding the local conditions

and the progress in sewage disposal that was there being made.

Mr. Dibdin told me of experiments he had begun at the Pimlico Station, which I visited, with regard to the quantities of sludge and the ways of disposing of it, owing to the sludge accumulation in the River Thames. Among these experiments I remember an endeavor to separate the sewage from the sludge, in order to give each a separate treatment.

About a year ago I wrote Mr. Dibdin concerning this question. He answered that in 1890, the year before I had seen him in London:

> We had been making a large number of experiments on the whole question of the treatment of the sewage of London, and the disposal of the sludge, the results of which were merely pigeon-holed, instead of being printed in full as is the fashion nowadays. . . . I up-ended an old 30-ft. boiler and used this as a tank 20 or 30 ft. deep and filled it with sludge from the million-gallon experimental plant and allowed it to rest for a week. Windows were placed at intervals to be able to watch the process. After a week a lively fermentation was taking place, the sludge overflowing down the sides and clear water appearing at the bottom. The staff was in a state of incipient rebellion on account of the stink! . . . This experiment became known as "The Pot of Porter."
>
> Personally I did not see the difference between putting the sludge from one tank into another to allow it to digest, and putting it on to one of those horrid and horridly misnamed abominations called a "Sludge Lagoon." . . .
>
> I commenced my experiments on the treatment of the London sewage in 1884 and without turning up the records it is difficult to remember all the details of the work carried out over ten years. I think we first tried settling the sludge in a separate tank in connection with our experimental work at the Pimlico Pumping Station in 1884 or 1885, as the engineers were pressing us to get out results as to the probable quantity which would have to be dealt with.

Mr. Clark says in the article referred to, that the first suggestion was made at the Lawrence Experiment Station in 1899, and refers to the report of 1899-1900, and the following quotation from p. 422 of this report presumably covers the fact to which reference is made:

> TREATMENT OF THE SLUDGE ONLY IN A SEPTIC TANK
>
> The observation that the stronger the sewage entering a septic tank the greater is the percentage removal of organic matter suggests the idea that, where exceedingly large volumes of sewage are to be purified, as in the case of the sewage of a large city, this sewage could be passed through ordinary settling tanks, so constructed that the sludge settling to the bottom of these tanks could be flushed into a septic tank and this sludge alone be treated by septic tank action, instead of attempting to treat the whole of a city's sewage. Following up this idea, a septic tank was put in operation during September, 1899, to receive the strong sludge from settled sewage. The results of this experiment during the period of operation in 1899 were that 75% of the organic nitrogen in the sewage entering the tank and 73% of the carbonaceous matters, as shown by the determination of oxygen consumed, did not appear in the effluent from it, the time of passage of the sewage through the tank being 48 hours. It is apparent, however, at the time of writing this report, that the tank is slowly filling with undissolved organic matter.

RUDOLPH HERING.

170 Broadway, New York City, Aug. 4, 1913.

Attacks on the Los Angeles Aqueduct

Sir—Referring to your editorial on the Los Angeles Aqueduct, in your issue of June 19, 1913, inasmuch as I was one of the four engineers who reported on the municipally-manufactured cement made for the Los Angeles Aqueduct, the result of which examination and report was unfavorable to the cement, I would ask the indulgence of your columns for a few words:

In the first place, the investigation and report were not made in the interests of private manufacturers [illegible] the purpose of discrediting the cement, but were undertaken at the request of the American Association of [illegible]ment Manufacturers solely for the purpose of ascertaining the facts as to the quality of the Los Angeles cement, it being understood that the plant was to be offered for sale in the near future. That the report was unfavorable to the product is no fault of the engineers making the investigation.

At about the same time we were making our investigation, some of this cement was shipped into the City of Los Angeles for use in constructing the 20th Ave. Bridge across the Arroyo Seco and upon being tested by the city engineer's office was found unsound and rejected. Did private interests seeking to discredit the cement also influence the city engineer's office in its finding? This can hardly be presumed to be so, as it is known that the city engineer is and has been on the most friendly terms with the management of the Aqueduct and its engineers.

In corroboration of the fact that the city-made cement used on the Aqueduct is undesirable, I may state that the cement plant has been offered for sale at a figure greatly below the cost to construct same, but there is no manufacturer of cement who fears it sufficiently to make an offer of any sort for the property. So far as I am able to judge, there is not the remotest possibility of selling this plant to private manufacturers of cement at any figure, since the product it can turn out is not standard in quality, and the only hope which the Aqueduct officials have is that they may be able to sell it to Los Angeles County, through the political influence of the city officials.

It is too soon to conclude that the cement is all right on the Aqueduct until the conduits lined with it have been tested with the full flow of water, viz., 400 cu.ft. per sec., for which the Aqueduct has been constructed for a period covering at least one year. From the appearance of the conerete lining and the softness of the material, it is probable that erosion and disintegration will occur within a few months after the full flow of 400 cu.ft. per sec. has been continuously passing through the conduit.

As to your criticism of "a local political faction" for making an attack on the Aqueduct, it may be of interest to inform you that the entire city administration responsible for the Aqueduct has been recalled and a new set of officials elected to replace them. The issue was the same as the one you refer to in the past, viz., a desire on the part of the public to know the facts concerning the Los Angeles Aqueduct. It may, therefore, be said that the local political faction referred to has been fully vindicated.

F. C. FINKLE.

Los Angeles, Calif., June 30, 1913.

[Mr. Finkle's letter has been referred by us to Homer Hamlin, city engineer of Los Angeles, for comment as to the municipally-made cement rejected for city bridge work, and also to J. B. Lippincott, until very recently assistant chief engineer of the Los Angeles Aqueduct, for comments on the letter as a whole. Their replies follow this note.

We briefly supplement and emphasize Mr. Lippincott's comment on the last paragraph of Mr. Finkle's letter. The election mentioned was not a "recall" election

in the usual acceptance of that term. It resulted from amendments to the city charter and not from a "recall" petition, and the charter amendments had no direct relation, if any relation at all, to the Aqueduct. We have assurances from a variety of sources other than Mr. Lippincott's letter that the Aqueduct, and particularly the character of the engineering work on the Aqueduct, was not a leading issue in the election. It also appears that every candidate who was avowedly against the Aqueduct administration was defeated.—Ed.]

Sir—In reply to your letter of July 18, 1913, inclosing proof of a letter by F. C. Finkle regarding cement manufactured by the City of Los Angeles at Monolith, Calif., I will say:

In April, 1912, three cars of cement was shipped to Los Angeles to be used on the Avenue 20 Bridge, then under construction. The specifications for this work required that the neat briquettes of cement, when tested, should develop a tensile strength of 450 lb. per sq.in. at 7 days and 550 lb. per sq.in. at 28 days. In this respect, the cement failed and was rejected.

I was informed that at the time this cement was made the supply of limestone was changed from the old to a new quarry and that difference in the character of the rock required a different mix of raw material, which was adjusted as soon as discovered.

Since the date mentioned above, I have tested other lots of Monolith Cement used by the Los Angeles Building Department in city work and have found it of exceptionally good quality. The department using the cement reports that excellent concrete was secured.

Homer Hamlin, City Engineer.

Los Angeles, Calif., July 26, 1913.

Sir—You have submitted to the writer a copy of a letter from F. C. Finkle, concerning the Los Angeles Aqueduct, bearing date of June 30, 1913.

There have been criticisms, due to local political conditions, which should have little interest to the engineering profession, except to indicate what the engineer engaged in public work may have to expect. The officials of the Aqueduct have refrained from entering into these discussions. It is believed that the majority of citizens of Los Angeles, including the substantial business organizations, thoroughly approve of the management of the Los Angeles Aqueduct. One does not enjoy disputes of this nature.

There are two origins for these attacks. First, some labor unions attempted to dictate certain wage scales on the Aqueduct. When they were unsuccessful, they called strikes of the allied trades, and the work, during the last two years of construction, was declared "unfair." When these organizations were unsuccessful in controlling the policy of the Board of Public Works, two years ago, the matter was thrown into politics during a municipal election through the organization of the Socialist Party, and a bitter campaign was waged, in which the Aqueduct was an issue. These efforts were overwhelmingly defeated at the polls. An investigation was requested by the Chief Engineer but under certain initiative provisions of the city charter, a hostile majority of Socialists were named for the committee. While the report of the committee criticised the work in many particulars, nothing ever came of it.

The origin of the second attack on the Aqueduct may be outlined briefly as follows: The city proposes to develop a large amount of electrical energy from the Aqueduct. There are several power companies delivering power in the city. They are conducting a successful business and naturally regard with concern the question of the city's policy. The city does not immediately require a large portion of this water within its present boundaries and is endeavoring to sell the surplus to adjoining towns and lands over which it expects to expand in the near future. Anything that can be done to embarrass the city in the disposition of the surplus waters of the Aqueduct necessarily means a delay in the development of the power. A campaign has been vigorously carried on in the surrounding country where the water would be sold to interfere with its disposition, and consequently with the development of power, as well as against the distribution of the power itself by the city.

Because of the similarity of their interests in attacking the Aqueduct, these two naturally diverging elements have had a common objective. Mr. Finkle has been identified with the interests of the power companies and is at present employed in litigation attacking the water rights of the city by the California & Nevada Power Co. During recent campaigns he has also been closely identified with the program of the Socialist-Labor opponents of the Aqueduct. This statement is made to throw a sidelight on his criticism. It is very difficult to avoid having one's judgment biased by his environments even though one's intentions are the best.

A feature of this general campaign against the Aqueduct has been the criticisms of the municipal cement works through the Association of American Portland Cement Manufacturers. The city has manufactured 900,000 bbl. of cement at its plant. The great bulk of this product has been above standard and very satisfactory, and the work which has been built with it, in some instances, is of a strikingly bold nature, notably the ten reinforced-concrete pipes, under heads as great as 75 ft. These conduits are 10 ft. in diameter, have 9-in. shells, and 2.7 miles of this pipe have now been filled with water for more than a year and are completely satisfactory.

Four engineers, of whom Mr. Finkle was one, representing the Association of American Portland Cement Manufacturers, went over the Aqueduct to inspect the work. It is known that the mill had been closely watched and the time selected for this trip was one when, owing to a necessary change in the limestone quarry, difficulties were being experienced. Those who have been engaged in the manufacture of cement are in a position to know what a delicate process it is. It is only partly one of precise chemistry. Physical conditions also have to be taken into consideration, and during a period of thirty days, at the time of this inspection, trouble was being experienced at the mill and most of the cement was being withheld from use. Unfortunately some of this cement which was below technical standards was shipped to the City Engineering Department in Los Angeles and was rejected. This is the cement referred to by Mr. Finkle. The Aqueduct cement, however, has been used in numerous other places in the city, in all classes of construction work, some of it of an unusual and severe nature, has passed severe laboratory tests before use, and has produced satisfactory work. [See also ac-

companying letter from City Engineer Hamlin regarding this cement.—ED.]

The Committee of the Cement Manufacturers were guided over the work by an employee who had been dropped from the Aqueduct organization and who was a member of the Committee. About twelve places were selected, where the work was claimed to be poor, and this alleged poor work was described as resulting from the use of a *municipally manufactured* cement. In fact the work at most of these places was constructed with cement that had been purchased from other mills.

In the illustrated report made to the Association of American Portland Cement Manufacturers views are given of test slabs which were made with the concrete aggregates used on the work and loaded to destruction. They manifestly were not a portion of the Aqueduct. Pictures of these broken slabs are labeled "Slabs of poor concrete, where cover on L. A. Aqueduct has already collapsed, and been replaced on desert west of Mojave." These gentlemen may not have known that these were test slabs, but the statement as made is unjust and indicative of the general tenor of their findings.

This report was supposed to be made on the concrete work of the Aqueduct for the Association of American Portland Cement Manufacturers and yet a number of views and criticisms are made of an unlined earthen canal, where no cement whatever was used in the construction. It is entirely possible to go over 235 miles of desert work and make criticisms and take photographs, which, when grouped together, would give impressions that are unfavorable.

The city has finished with the cement mill and naturally wishes to sell it, and the cement manufacturers just as naturally wish to prevent this. The city has already had one offer, which was rejected, and a second offer is now presented. If the city attempted to produce the cement necessary for its own consumption alone, the mill would have to be run at one-third capacity, which is not economical. The mill has been reported on by some of the most eminent authorities and they found that the materials are suitable for the production of good cement and that the product was acceptable. The multitude of tests that have been made, not only by the Aqueduct laboratories, but by others, show the cement to be above standard, save in exceptional cases, such as are apt to occur with any mill.

Mr. Finkle expresses the opinion that the Aqueduct concrete will begin to show erosion after a few months, after a flow of 400 cu.ft. per sec. is turned into it. From 100 to 500 cu.ft. per sec. of silty water has now been flowing in the northerly 40 miles of lined Aqueduct into the Haiwee Reservoir for the past six months and no such ill effect can be observed. From the Haiwee Reservoir south the clear water without silt will be drawn from large reservoirs, and it is difficult to see how there would be erosion, even if the concrete were poor.

Mr. Finkle's final criticism is to the effect that the entire city administration, responsible for the Aqueduct, has been lately (May, 1913) recalled and a new set of city officials elected to replace them. This is as surprising a statement as that concerning the construction work. The Aqueduct was not an issue during the last election. The city council consists of nine members. Seven of the old members again ran for office. Six of them were reëlected, all of whom support the Aqueduct; one failed. Two members of the committee which investigated the Aqueduct unfavorably ran for the city council and were defeated. The previous mayor did not again desire office and was not a candidate. The representative of the Socialist Party who attacked the Aqueduct viciously, was dropped out of the running for mayor at the primaries. Both of the remaining candidates for mayor commended the work of the Aqueduct. Since Mr. Finkle wrote the letter under consideration here his name was sent to the council by the new mayor for confirmation as a police commissioner, but it became so apparent that he would be rejected unanimously by the council, because of his attacks on the Aqueduct, that it was withdrawn.

As far as known, all prominent city officials are in accord with what has been done on the Aqueduct. The work is finished and the organization disbanded. The writer is no longer connected with the city government.

In conclusion I think it may fairly be stated that Mr. Finkle's judgment in matters relating to the Aqueduct is biased to such an extent that he has probably misled himself. He has attacked everything concerning this proposition since its inception. He has predicted that the cost of the work would be double the estimate and what it actually did cost. He has condemned the quantity of water available, the quality of the water, the character of the cement, and in short appears to believe that everything pertaining to the enterprise is unsatisfactory. Under our American institutions a man has a right to think what he pleases and pretty much to say what he thinks. At the same time in view of the importance of this plant to his own home city and of his published criticisms thereof, it is well for the general public to consider the environment in which he does his thinking.

J. B. LIPPINCOTT.

Central Bldg., Los Angeles, Calif., July 30, 1913.

The Aërial Cableway for Passenger Traffic on the Kohlererberg, Bozen, in the Tyrolese Alps, described in our issue of Nov. 28, 1912, p. 985, was opened to the public on May 10, 1913, after having been tested by the authorities. No less than 92 catch tests were made with the cars on the cableway, with the invariable result that they were found to be safely and reliably held to the double cables by the emergency grips. About 10,000 persons were conveyed in the first five weeks of operation. The cableway was built on the system of Bleichert's Aërial Transporters, Limited, London, E. C., and has a length of about 5350 ft., with a difference in level of about 2750 ft. The traffic is handled by two cars, each of which is capable of carrying 16 persons.

An Incline Railway up Table Mountain, at Cape Town, South Africa, has been proposed and a report on two projects has been made to the city council by H. H. Peter, Consulting Engineer. One project is for a rack railway of standard gage, with grades of 35 to 36.7%, and curves of 246-ft. radius. The line would be about two miles in length, operated by electricity, the motors developing 280 hp. on the main cog wheel, and the 32-ton train (with 80 passengers) having a speed of 3½ m.p.h. The line would start from the end of the present electric suburban line at Kloof Nek, with an elevation of 782 ft., and its upper end would be 3509 ft. above sea level. The estimated cost, including equipment, is $550,000.

The other project is for a double section of cable incline, with a gage of 3 ft. 3⅜ in., and would be independent of the present electric lines. Starting at Rockland (elevation 476 ft.) the first section would be 0.73 mile long (horizontally) with grades of 15.5 to 36.6% to the intermediate station at Platte Klip (1244-ft. elevation). The second section would be 0.81-mile lay, with grades of 27.5 to 67.7% to a summit elevation of 3490 ft. On the first section, 7-ton cars holding 40 pasengers would be run at 8.2 ft. per sec. On the second section, 6-ton cars with 53 passengers would be run at 4.5 ft. per sec. The estimated cost, including equipment, is $375,000, the saving being in roadway construction and rolling stock. In both cases, a traffic of 45,000 passengers per year is estimated. Mr. Peter recommends the cable line as being the more likely to prove commercially successful.

William T. Rossell; the New Chief of Engineers, United States Army

Brig.-Gen. William Trent Rossell, who became Chief of Engineers, U. S. A., by the voluntary retirement of Brig.-Gen. William H. Bixby, on Aug. 11, was born in Alabama, Oct. 11, 1849. His father also was an officer of the United States Army, the late Bvt.-Maj. William H. Rossell.

William T. Rossell was appointed a cadet at the United States Military Academy at West Point in 1869, and he graduated in 1873 the third in his class of which Gen. Bixby was at the head. On June 13, 1873, he received his commission as Second-Lieutenant, Corps of Engineers, and he has served as an officer of the Corps of Engineers ever since. He was promoted to be First Lieutenant in 1877, Captain in 1884, Major in 1896, Lieutenant-Colonel in 1904 and Colonel in 1908.

After serving a few years at the Engineer School at Willets Point, N. Y., Lieut. Rossell was appointed Assistant Professor of Engineering at West Point, where he served from 1876 to 1880. From 1880 to 1882 he was stationed at Portland, Me., and the following two years at Charleston, S. C., Jacksonville, Fla., and Fort Monroe, Va., on river- and harbor-improvement work.

In January, 1885, Capt. Rossell was placed in charge of the fortification works at Forts Marion, Taylor and Jefferson on the coasts of Florida, and the river- and harbor improvements at Key West, Tampa Bay and Cedar Keys. From here he went to the Mississippi River work as the officer in charge of the Third District, and as a member of the board of officers on the building and repair of the levee system. For a part of the four years he spent on the Mississippi problem he was in charge of the First District.

Capt. Rossell was appointed Assistant to the Engineer Commissioner of the District of Columbia in 1890, and two years later was commissioned by the President of the United States, Engineer Commissioner of the District of Columbia. During his term as Engineer Commissioner he served also as a member of the Rock Creek Park Commission.

From 1893 to 1895 he served with the engineer troops and as an instructor at Willets Point, serving during the latter part of this period in command of that post, the batallion of engineers and the engineer school. He also had charge of the coast defense fortifications at Fort Schuyler and Willets Point and the construction of the seawall at Davids Island. From 1895 to 1901 Maj. Rossell was in charge of fortifications and harbor work in Alabama, Mississippi and Louisiana, with headquarters at Mobile, Ala. During this period he was a member of the board for examination of officers of the Corps of Engineers for promotion. From 1901 to 1906 he was Engineer of the Third Lighthouse District, serving a part of the time as a member of the board on the improvement of the Connecticut River.

Col. Rossell was in charge of the Ohio River improvements between July, 1906, and October, 1909, which included the construction of Lock and Dam No. 37. He was also Engineer and Division Engineer of the Central Division of the Lighthouse Service; in 1909-'10 he was a member of the Lighthouse Board. He was a member, and for some time Acting President, of the Mississippi River Commission. In October, 1909, he was appointed Engineer of the Third New York District in charge of river and harbor improvements in the State of New Jersey. Later he was Division Engineer of the Eastern division and President of the New York Board for the examination of officers of the Corps of Engineers for promotion. Subsequently, he was appointed senior member of the permanent Board of Engineers for Fortifications, and senior member of the Board of Engineers for Rivers and Harbors and of the New York Harbor Line Board. In this latter capacity he has had much to do with the current controversy between the federal and city authorities in regard to the extension of the North River piers.

A Typhoid Outbreak Apparently Due to Polluted Water Cress

Water-cress sandwiches served at a wedding breakfast are the most likely explanation yet found for 18 cases of typhoid fever, including the bride and bridegroom, which have since developed among the 43 wedding guests. Of the 19 guests who ate the water cress, only one escaped typhoid. While no typhoid history, prior to the outbreak, has yet been associated with the water cress, the water in the bed from which the cress was taken has been found to be polluted, as stated below and as may be inferred from the accompanying view.

The wedding breakfast at which the cress was served took place in Philadelphia. We are indebted to John A. Vogelson, Chief of the Bureau of Health of Philadelphia, for the following concise statement of the facts in the case and the conclusions thus far drawn:

In the matter of the reported tracing of typhoid fever to an infected water-cress bed, I would state that the investigation is not yet completed. A premature but unofficial announcement was made in the daily press. Later, of course, the Health Department was interviewed, but as yet we have not made a positive statement that it was the water cress. The facts are briefly as follows:

A Polluted Water-Cress Bed Which May Have Caused a Typhoid Outbreak

(The small building in the center of the view is a privy and is located at the head of the cress beds. Beneath or near the trees at the rear of the privy is "another spring")

At a wedding breakfast on June 24, there were 43 guests in attendance. By July 22, 18 of these were reported as ill with typhoid fever. Only two of them were in Philadelphia, but the remaining 16 cases were scattered through suburban territory and in summer resorts along the Atlantic coast, as far as Maine.

Investigation of the milk, water, and food handlers have given negative results. The menu was secured from a caterer, and the guests have reported on the articles of food of which they partook. Tabulation shows that 19 ate water-cress sandwiches, and of these 18 are reported ill with typhoid. It was suggested that possibly the ice cream was at fault, but all inquiries to date have given negative results. Twenty-seven of the guests ate ice cream, 11 of whom are ill. All of the 11 ate water cress. Seven persons who did not eat ice cream have the typhoid fever.

These facts having been determined, the search then led to the place where the water cress was secured and where it was grown. The inclosed small photograph speaks for itself. While no typhoid has been reported on these premises, yet examination of the water from the cress bed shows high pollution and presence of coli. We have not as yet isolated the typhoid germ. The cress bed being beyond our jurisdiction, the State Department of Health was communicated with and immediately stopped the sale of the cress and has taken steps for the correction of unsanitary conditions.

I am, of course, unable to say positively that it was the water cress which caused the outbreak, but every indication is that it could have come from the cress bed, and we have found all other lines of inquiry negative up to the present time.

A Philadelphia newspaper describes the man who raised the water cress as a "Marple farmer" who "has been serving a number of exclusive cafes and restaurants" in Philadelphia and who leases a six-acre plot of land forming a part of a 350-acre farm.

The Interstate Commerce Commission's Report on Railway-Track Scales

An extensive report on railway-track scales has just been issued by the Interstate Commerce Commission under the authorship of Commissioner Prouty, who conducted a 46-day investigation into the subject. The investigation was started as a result of a number of complaints from shippers that the ordinary track scales used by the railways were quite inaccurate, which inaccuracies have resulted in the imposition of unreasonable charges and discrimination between the shippers. As a result of his investigation Commissioner Prouty found that the majority of track scales in use at the time of the starting of the investigation, at least, were inaccurate and should be rebuilt in order to obtain reasonably accurate results. It was also apparent that many additional scales should be installed.

The commissioner summarizes the result of the investigation as follows:

Looking at conditions as they existed when the order instituting this investigation was made on Jan. 15, 1912, this can be affirmed with some confidence. Three-fourths of all the track scales in use in the United States were of defective design or improperly installed. Less than one-fourth were properly inspected. Not more than 10% were accurately tested and the majority were not in any proper sense tested at all. The methods of weighing were heedless and unsatisfactory in many cases. The stencil tare weights upon 80% of all cars were erroneous. While check weighing at certain points where better facilities were available and superior operating conditions prevailed tended to reveal many of the original erroneous weights, these changes in the original weights were a source of constant irritation and inconvenience to shippers.

The investigation attempted to ascertain (1) to what degree of accuracy the scale could reasonably be expected to weigh, (2) whether the cars can be weighed in motion with reasonable accuracy, (3) whether cars should be weighed while coupled at one or both ends.

In regard to the first the report states that a modern scale properly installed and kept in proper condition should be accurate within at least 100 lb. When under test it shows a variation of 100 lb. or more it should be considered out of order. All scales should be tested by a test car at least once in two months, in many cases once every month. In regard to the second question the report states that cars should never be weighed in motion coupled at both ends. They may, on account of conditions of operating economy, be weighed in motion when uncoupled upon scales especially designed for that purpose and in charge of thoroughly competent men, but cars should not ordinarily be weighed when coupled at one end and never unless at points where the greatest attention is paid to the conditions of scale and the competency of the weighmaster.

The commissioner endeavored to find out whether the various automatic and semi-automatic weight-recording devices were of value, but he was unable to decide either in favor or against them. It was found that obviously a scale would weigh a car most accurately when that car

had come to a dead stop unattached to any other car, but that this would add so much to the cost of weighing that it is impracticable.

A prolific source of error is the wrong stenciling of the tare weight of cars. When the car weighs more than the stencil tare the shipper loses, while when the car weighs less than the stencil tare the shipper gains. The railways claim that this inaccuracy is balanced by the number of cars above and below the average. The commissioner well pointed out that one shipper who happens to have his goods weighed in a car stenciled above its weight and, therefore, is forced to pay an excess charge on his goods is not appeased by the statement that some other shipper has happened to draw an underweight car and has paid less than he should have. While the balance averages itself in the long run for the railway, it does not average itself for any but the very largest shippers.

As a result of the investigation the commission advances its opinion that some federal tribunal, perhaps the Interstate Commerce Commission itself, should be given authority in the following respects: (a) To fix the points at which track scales shall be installed, (b) to prescribe the standard of such scales and their installation, (c) to test or supervise the testing of such scales and (d) to supervise the operation.

The commissioner remarked that since the initiation of the investigation many railroads have discovered the lack of accuracy in their track scales and have commenced an ordered investigation of the subject and in many cases have already revised their scales and methods of weighing with much more accurate results.

The Season's Third Break in Welland Canal Locks

By Emile Reed Lowe*

The third serious break of the season occurred in the Welland Canal on Aug. 2, 1913, when the steel steamer "Lehigh" carried away the lower gates of Lock No. 23 and did considerable damage to the retaining wall just below the lock, as well as staving a large hole in the bow of the boat. Lock No. 23 is near the top of the Niagara Escarpment and is in the center of the town of Thorold. The lock extends due north and south, while the canal level below swings abruptly about 45° to the east; the west retaining wall being about 30 ft. above the Welland Division of the Grand Trunk Railroad, which parallels the canal through Thorold.

The accident happened about 2:30 in the afternoon and was caused by the snapping of the tie lines on the boat. The steamer "Colling" had just locked up through No. 23 and the "Lehigh" immediately came into the lock bound down to Lake Ontario. The "Lehigh" had been made fast and the upper gates were being closed when the "Colling" began to move forward to enter Lock No. 24, which is only a few hundred feet above No. 23. The steaming ahead of the "Colling" set up a current with sufficient force to break the lines of the "Lehigh" and the big steel boat crashed into the 2-ft. gates, smashing the top off each gate about half way down.

The water in the lock immediately poured into the level 14 ft. below and carried the ship with it, forcing her against the stone retaining wall with such force as to stave a large hole in her bow just below the water line. The large volume of water from the lock quickly filled the level and overflowed the west wall, flooding the railway track and Thorold station below, and doing damage enough to block traffic for several hours.

*The Beaver Companies, Thorold, Ont.

A Fall of Rock from the roof of the Catskill Aqueduct tunnel near Shaft 2, Mosholu Parkway and Jerome Ave., the Bronx, New York City, Aug. 1, killed one workman and injured five. The rock is reported to have weighed about four tons.

A 14-in. Gun Burst at the Naval Proving Ground at Indian Head, Md., July 30. According to a statement by the acting Secretary of the Navy, the gun burst at the breech end while being "proof-fired" The pressure at which the gun burst was 20½ tons, approximately four tons above the service pressure. No one was injured.

A Double Explosion in the East Brookside Mine of the Philadelphia & Reading Coal & Iron Co., near Tower City, Penn., Aug. 2, caused the death of 18 men and seriously injured two others. Press dispatches state that the cause of the explosion is not known.

Noxious Gases Following a Blast at Shaft 20 of the Catskill Aqueduct, New York City, Aug. 6, overcame 16 men. It is reported by the press that following the blast the air pump was operated as usual for removing the dangerous fumes. The gang of 16 men then went forward to remove the blasted rock and all lost consciousnes. All were resuscitated.

A Freight Wreck on the Louisville & Nashville R.R., at Noonday station, near Marietta, Georgia, Aug. 6, caused the death of four trainmen and one tramp. The locomotive and 10 cars rolled down an embankment. Press dispatches state that the wreck was probably caused by a washout resulting from recent heavy rains.

The Production of Coal in West Virginia reached its highest mark in 1912 when it surpassed its previous record, made in 1910, by over five million tons, according to the United States Geological Survey. The coal area embraces 17,000 of the 24,022 sq.mi. in the state, and the production for 1912 was nearly 67 million tons, practically all bituminous or semi-bituminous. For the past four years, West Virginia has held second place, among the states in the quantity of coal produced.

A Fire on the Wooden Floor of the upper deck of the new Oregon-Washington Ry. & Navigation Co. bridge at Portland, Ore., on July 30, caused serious damage to the structure and put it out of service for several days. This bridge was described in "Engineering News," Dec. 12, 1912, p. 1100. It is now known as the Harriman Bridge. It consists of two fixed spans, each 287 ft. long and a central lift span of the Waddell & Harrington type of 220-ft. span. For the two fixed spans there is a highway deck on top and a railway deck along the level of the lower chords. As stated in our previous article, the upper deck is divided into five parts, a 28-ft. central section for the double-track street railway and for automobiles, an 11-ft. roadway on each side for horse vehicles, and on the outside a sidewalk of 6 ft. clear width at each side of the structure. The roadway and car track spaces are paved with wood blocks treated with 10 lb. of creosote. These are placed on tar paper which rests on a floor of 4-in. planks laid in turn on 7x9-in. ties all treated with 10 lb. of creosote. The floor covering of the 6-ft. sidewalk is not treated.

A dispatch from G. W. Boschke, Chief Engineer of the railway company, states that the upper roadway floor burned from 3 to 6 p.m., July 30, and that repair work was started immediately so that the lower deck was opened for trains, 7 a.m. July 31, the upper deck opened for street cars, 5 p.m., Aug. 2, and the draw span put in operation for the river traffic 6:30 a.m. Aug. 2.

No vital members of the steel work were damaged, but the light steel members of the upper deck and the floor there were damaged to the extent of about $53,000. When put into service the two lifting decks worked perfectly.

The cause of the fire is not known.

Control of a Group of Electric Railways in Massachusetts (the Springfield Street Ry., Worcester Consolidated Street Ry., Milford, Attleborough & Woonsocket Street Ry., Attleborough Branch R.R., Interstate Consolidated Street Ry., Worcester & Webster Ry., and the Webster & Dudley Street Ry.), it is announced, has been secured by the engineering firm of Sanderson & Porter, New York City. These lines were owned by the New England Investment & Security Co., of Springfield, Mass., which was organized in 1906 to take over certain trolley properties of the New York, New Haven & Hartford

R.R. This company was capitalized for $10,000,000 preferred stock and $100,000 common, only the latter having voting rights. Only about $4,000,000 preferred was absorbed by the investing public, however. There is on record no connection of the New England company with the New Haven road, beyond the latter's guarantee of 4% on preferred stock of the former, and of a liquidation value of $105 per share. It has been generally regarded, however, that control of the $100,000 common, carrying control of the properties, was in the hands of persons friendly to the New Haven road.

Around the World in 35 Days is the record just made by J. H. Mears, a representative of "The Evening Sun," of New City. Mr. Mears left New York City on the "Mauretania," on July 2, crossed Europe and Asia by railway, via Paris, Berlin, St. Petersburg and Fu San, the Pacific Ocean by steamer and hydroaëroplane (the latter for a two-hour trip en route from steamer to shore at Seattle) and the United States via the Northern Pacific and New York Central railways, reaching New York on Aug. 6, 35 days, 21 hr., 35 min. after he had left. Although several changes had to be made in the route outlined, he made precisely the time figured before the trip. The main divergence from his plan was the use of the Corean railways to Fu San, forced by a delay from a washout on the Trans-Siberian Ry., on which he was bound for Vladivostock. The previous record of 39 days, 19 hr. 44 min. was held by André Jager-Schmidt, a Paris newspaper man.

Power Development in U. S. Forest Reserves is being greatly increased by permits recently granted and pending in the Department of Agriculture. On July 16 the Secretary issued a permit to the Pacific Light & Power Corporation, of Los Angeles, Calif., to construct and operate a series of plants in the Sierra National Forest, northeast of Fresno. The project comprises four stations, two reservoirs and some 25 miles of concrete-lined tunnel together with a transmission line 240 miles long. The permit provides for a construction period of 12 years. Two steps in the scheme have already been put under way, both included in the Big Creek development, described in our issue of Nov. 7, 1912. At that time the revised forms were not ready and it was agreed that a permit would be accepted on the old form, but to be superseded by one on the new plan at an early date.

The third step is that known as the Mammoth Pool project on the San Joaquin River, and the fourth is lower down on the same stream. The ultimate proposed installations of machinery in the four plants noted are respectively for 80,000, 70,000, 100,000 and 24,000 hp. or a total of 274,000 hp. The government estimate, based on minimum natural flow according to the regulations of the Forest Service, gives a natural total capacity of 127,000 hp., but for figuring rentals this is reduced by 10% for privately owned reservoir and pipe line lands and by 25% for energy loss on the long transmission line. Earlier permits covering these projects have been granted to various persons and concerns, but are now superseded by that of July 16, noted.

A Permit for Power Development on the Pend d'Oreille River in Washington, has been granted to the International Power & Manufacturing Co., by joint action of the Departments of Agriculture, Interior and War. Part of the proposed construction work is in the Kaniksu National Forest. The stream flow at lowest stages allows the development of 120,000 hp. and by use of storage reservoirs this can be increased to 350,000 hp. for years of low precipitation. The permit is indeterminate as to time, but is revocable for violation of its terms or of the provisions of the general regulations, or pursuant to provisions of the Water Power Act (of Feb. 15, 1901). It is subject to revision once in each 20 years to meet the requirements of the then existing regulations. These unusual conditions are granted since the power generated is largely for the development of the artificial-nitrate industry. A maximum charge to consumers of 6c. per kw.-hr. is fixed, and this scales down to 0.2c. per kw.-hr.; rental charges of the government are to be reduced for reductions in rate schedules.

Three 30,000-kw. Steam-Turbine Generating Units are to be built by the Westinghouse Machine Co. and the Westinghouse Electric & Manufacturing Co. of Pittsburgh, for the Interborough Rapid Transit Co., of New York City. These are to be compound Parsons type turbines, rated at 45,000 hp., each with separate high- and low-pressure sections driving a single generator. These units will replace older reciprocating engines and generators in the power house of the Interborough company (Manhattan Elevated Division) at 74th St. and East River. The added capacity of the reconstructed station will be necessary to care for the load brought by the third-tracking and extensions of the elevated roads under the rapid-transit contracts recently signed. The turbines are to be ready for service in about a year. These large machines replace what were at installation the largest engine-driven generating units then built—5000-kw. machines driven by 8000-hp. engines.

A 35,000-k.v.a. and a 30,000-k.v.a. steam-turbine generating unit has been ordered by the Philadelphia Electric Co. from the General Electric Co., of Schenectady, for installation in an extension of the present main power station of the former company at Christian St. and Schuylkill River, in Philadelphia. According to conservative practice, the horsepower rating of the larger unit would not be less than 47,000 hp. and might run over 50,000 hp.

The Award in the Richmond, Va., Bridge Competition, for a new concrete bridge across the James River at the site of the present Free Bridge, has been announced by the Administrative Board of the city. Benjamin H. Davis, of New York City, was awarded the first prize of $1500, and Robert A. Cummings, of Pittsburgh, Penn., the second prize of $500. Honorable mention was made of the design by Roelker & Scarborough, of Richmond, Va.

This competition was noted in "Engineering News," May 29, 1913, p. 1134 and June 26, 1913, p. 1350. It was advertised the last week in January, and the competition closed Apr. 15. After a lackadaisical examination of the plans by the Administrative Board, a lay elective body, and following a severe criticism of the method of carrying on the competition by this journal, the Board, on June 18, appointed a board of engineers to recommend the best designs out of the 27 submitted. The present award is presumably based on the report of this engineering board. There is no present prospect of the bridge being built.

Mr. Davis is a New York engineer, formerly connected with the Lackawanna R.R., where he had charge of the design of a number of large concrete bridges. He is also the designer of the large concrete bridges now approaching completion at Reading and at Allentown, Penn. Mr. Cummings is a well known Pittsburgh engineer.

PERSONALS

Mr. W. E. Baldry, formerly with Worley & Black, Consulting Engineers, Kansas City, Mo., has been appointed City Engineer of Dodge City, Kan.

Mr. George E. Patterson, formerly Trainmaster of the Illinois Central R.R., at Chicago, Ill., has been promoted to be Superintendent at Clinton, Ill.

Mr. W. F. Miller, formerly Supervisor on the New York division of the Pennsylvania R.R., has been appointed Supervisor and Assistant Trainmaster at Lewisburg, Penn.

Mr. G. B. Taylor, of Petersburg, Ind., has been appointed to a position on the electrical engineering staff of the Indiana Public Service Commission at a salary of $2500 per annum.

Mr. Paul D. Sargent, M. Am. Soc. C. E., Assistant Director, United States Office of Public Roads, has been appointed State Highway Engineer of Maine, at a salary of $5000 per annum.

Mr. F. W. Heiskell, for the past two years Assistant Advertising Manager of the International Harvester Co. of America, has been promoted to be Advertising Manager, with headquarters at Chicago, Ill.

Mr. Carl C. Witt, M. Am. Soc. C. E., Engineer of the Kansas State Public Utilities Commission, Topeka, Kan., has resigned to accept a position under the Interstate Commerce Commission at Washington, D. C.

Mr. Guy Hopkins has been appointed Acting General Superintendent of the Louisiana Western R.R. and Morgan's Louisiana & Texas R.R. & Steamship Co., at New Orleans, La., succeeding Mr. H. W. Sheridan, resigned.

Mr. H. J. Macintire, M. Am. Soc. C. E., formerly Instructor in mechanical engineering at the Carnegie Institute of Technology, has been appointed Assistant Professor of mechanical engineering at the University of Washington, Seattle, Wash.

Mr. J. A. Gordon, formerly General Superintendent of the Pere Marquette R.R., has been appointed General Superintendent of the Western district, comprising the Chicago, Petoskey and Detroit divisions, with headquarters at Grand Rapids, Mich.

Mr. T. J. Strickler, Assoc. M. Am. Soc. C. E., of the engineering staff of the Kansas State Public Utilities Commission, Topeka, Kan., has been appointed Engineer, succeeding Mr. Carl C. Witt, M. Am. Soc. C. E., resigned, as noted elsewhere.

Mr. W. F. Kaderly, General Superintendent of Motive Power of the Georgia Southern & Florida Ry. and the Macon & Birmingham Ry., has been appointed General Superintendent of the Hawkinsville & Florida Southern Ry., with office at Macon, Ga.

Mr. B. C. Byers, formerly Terminal Superintendent of the Cleveland, Cincinnati, Chicago & St. Louis R.R., at Cincinnati, Ohio, has been appointed Superintendent of the Peoria & Eastern division at Indianapolis, Ind., succeeding Mr. M. E. Neville, promoted.

Maj. James P. Jervey, M. Am. Soc. C. E., Corps of Engineers, U. S. A., who has been transferred from the Panama Canal work, as noted in our issue of July 31, is to be stationed at Rock Island, Ill., in charge of the U. S. Engineer Office in that city.

Maj. George M. Hoffman, Corps of Engineers, U. S. A., recently Resident Engineer in charge of the construction of the Gatun dam and spillway, Panama Canal, has been transferred from the Isthmus to Wheeling, W. Va., to take charge of Ohio River work in that vicinity.

Mr. Frank O. Maxson, M. Am. Soc. C. E., Civil Engineer, U. S. N., has retired under the age limit. Until recently Mr. Maxson was stationed at Key West, Fla. He was born in Connecticut and was appointed Assistant Civil Engineer in 1881. He retires with the rank of Captain.

Mr. W. C. Hurst, formerly General Superintendent of the Chicago, Peoria & St. Louis R.R., at Springfield, Mo., has been appointed General Superintendent of the Eastern district of the Pere Marquette R.R., with headquarters at Saginaw, Mich. The Eastern district comprises the Toledo, Port Huron and Canadian divisions.

Mr. Albert Le Monnier, a graduate of the Ecole des Beaux Arts, an architect of Paris, France, has been appointed Assistant Professor of architectural design at the Massachusetts Institute of Technology. Mr. Le Monnier has received more than 50 awards in various competitions of the Ecole des Beaux Arts. He is not yet 30 years old.

Mr. Hugh L. Cooper, M. Am. Soc. C. E., Consulting Engineer, of New York City, and Chief Engineer of the Mississippi River Power Co.'s hydro-electric development at Keokuk, Iowa, was the guest of honor of 100 citizens of Keokuk at a farewell banquet on July 25. Mr. Cooper was presented with a bronze medal, appropriately inscribed to commemorate the completion of the project.

Mr. C. D. Porter, recently Assistant Master Mechanic of the Pennsylvania R.R., at Pittsburgh, Penn., has been appointed Assistant Engineer of Motive Power in the office of the General Superintendent of Motive Power, at Altoona, Penn. Mr. Porter was born in 1883 and graduated from Purdee University in 1902. He entered the service of the Pennsylvania R.R. in July, 1902, as a special apprentice.

Messrs. Nathaniel B. Ellery, M. Am. Soc. C. E., former State Engineer of California, and William F. Martin, Assoc. M. Am. Soc. C. E., recently District Engineer of the United States Geological Survey, in California and Hawaii, and at present Assistant Professor of engineering mechanics at the University of California, have formed a partnership under the firm name of Ellery & Martin, Civil & Consulting Engineers, Merchants Exchange Bldg., San Francisco, Calif.

Maj. William W. Harts, M. Am. Soc. C. E., Corps of Engineers, U. S. A., has been appointed Superintendent of Public Buildings and Grounds, Washington, D. C., to succeed Maj. Spencer Cosby, M. Am. Soc. C. E., Corps of Engineers, U. S. A., who is detailed to be Military Attaché of the United States Embassy at Paris, France. The officer in charge of public building and grounds in the District of Columbia is also Military Aid to the President, and has the rank and pay of Colonel.

Mr. G. T. Slade, former Third Vice-President of the Northern Pacific Ry., has been made First Vice-President. Mr. Slade was born in New York City in 1871, and graduated from Yale University in 1893. He has passed through the various grades in the operating department of the Great Northern Ry. from clerk, timekeeper and Assistant Roadmaster to General Superintendent. In 1907 he was made General Manager of the Northern Pacific Ry., and in 1910 Vice-President.

Mr. W. P. Clough, First Vice-President of the Northern Pacific Ry., has been elected Chairman of the Board of Directors, succeeding to a part of the duties of Mr. Howard Elliott, President, who has resigned to become Chairman of the Board of Directors of the New York, New Haven & Hartford R.R., as noted in our issue of July 31. Mr. Clough began his railway work as Assistant to the President of the St. Paul, Minneapolis & Manitoba Ry. in 1887. He has been Vice-President of the Northern Pacific Ry. since July, 1912.

Mr. Josiah Gibson, formerly Structural Engineer, Illinois Steel Co., Chicago, Ill., announces the opening of an office at 921 Black Bldg., Los Angeles, Calif., as a Structural Engineer. Mr. Gibson is a graduate of Cornell College, Iowa, and has been in structural-steel design work for the past 17 years, with the Chicago, Milwaukee & St. Paul Ry., the American Bridge Co., the Wisconsin Bridge & Iron Co., and the Illinois Steel Co. He designed the structural-steel work of the stone-crushing plant of the Casparis Stone Co., described in our issue of Jan. 16, 1913.

Mr. George H. Fenkell, M. Am. Soc. C. E., has been appointed Commissioner of Public Works by the Mayor of Detroit, Mich. Mr. Frankell has been connected in various capacities with the Board of Water Commissioners of the City of Detroit since 1894. During this period he has twice resigned his position in Detroit, and at one time, from 1902 to 1908, was Civil Engineer to the Commissioners of Water Works of the City of Erie, Penn. Recently Mr. Feenkell was Civil Engineer to the Board of Water Commissioners of Detroit.

Mr. Jean Frederick Weilhorski, an architect of Tours, France, has been appointed Rotch Professor of architectural design at the Massachusetts Institute of Technology. Mr. Weilhorski is a graduate of the Ecole des Beaux Arts, from which he has subsequently received prizes and medals, including the second Rougevin prize in 1900, the Godeboeuf prize in 1901, the Prix Labarre in 1902, and in 1903 he was awarded the second Grand Prize of the school. In 1900 and again in 1902 he was designated laureate of the Central Society of French Architects. Mr. Weilhorski succeeds the late Prof. Constant Désiré Despradelle.

Mr. J. M. Hannaford, Second Vice-President of the Northern Pacific Ry., has been elected President and will be in charge of operation, following the resignation of Mr. Howard Elliott, who was recently elected President of the New York, New Haven & Hartford R.R. Mr. Hannaford is a native of New England, born in Claremont, N. H., in 1850. He entered the railway service in 1866 as a clerk in the freight office of the Central Vermont Ry., at St. Albans, Vt. It was about the same time and in the same place that two other now prominent railway officials were then receiving their preliminary training, Messrs. E. J. Chamberlin, President of the Grand Trunk Ry., and Charles S. Mellen, President of the New York, New Haven & Hartford R.R. In May, 1872, Mr. Hannaford went to the Northern Pacific Ry. as chief clerk, and he has remained with that railway since, having passed through all the grades in the freight traffic department from clerk to Vice-President. He is also President of the Northern Pacific Express Co.

Prof. Albert Sauveur, M. Am. Inst. M. E., Professor of metallurgy at Harvard University, has been awarded the Elliott Cresson Gold Medal of the Franklin Institute of Philadelphia, Penn., in recognition of his numerous and important contributions to the science of metallography, and the influence he has had in bringing this science into practicable and exceedingly useful application in the iron and steel industry. Prof. Sauveur was born in Belgium in 1863. He came to this country at an early age. In 1889 he graduated from the Massachusetts Institute of Technology in mining and metallurgy. He was Chemist and Metallurgist with various steel companies until 1897, when he established the Boston Testing Laboratories. He was also Editor and Proprietor of the "Metallographist," which was succeeded in 1903 by the "Iron and Steel Magazine," of which Prof. Sauveur was also Editor and Publisher until he joined the Harvard University faculty. Prof. Sauveur is the author of several text-books, and is a member of scientific societies in this country and England.

Mr. T. E. Byrnes, former Vice-President of the New York, New Haven & Hartford R.R., is to be President of the new steamship company to operate the lines owned by the railway company. According to the Boston "Transcript," plans for the reorganization of the marine department of the New Haven road are well under way, and will be carried out substantially as recommended by the Interstate Commerce Commission. The Panama act of 1911 requires railroads engaged in interstate commerce to divest themselves of all competing steamship lines, on or before July 1, 1914, except in so far as they may be permitted by the Interstate Commerce Commission to retain these lines in the public interest.

Mr. James H. Hustis, Vice-President and operating head of the Boston & Albany R.R., is to become President and operating head of the New York, New Haven & Hartford R.R. under the new scheme of organization. Mr. Hustis was born in New York City in 1864, and at 14 years of age began his railway experience as an office boy for the General Superintendent of the New York Central & Hudson River

R.R. Ever since that time he has remained in the service of the New York Central and its subsidiary lines. In 1891 he was promoted to be Trainmaster, in 1900 to be Division Superintendent, in 1907 to be General Superintendent of the Western district. In October, 1907, he went to the Boston & Albany R.R. as Assistant General Manager, and in 1911 he was made Vice-President in charge of operation.

OBITUARY

John W. Kerney, a pioneer engineer of California, died Aug. 3, at the age of 71 years. He was a native of Paterson, N. J., and went to California when a young man. He was the first Chief Engineer of the old Clay St. cable railway.

C. R. Guerther, Construction Superintendent for J. G. White & Co., New York City, on the construction of the new station of the Marconi Wireless Telegraph Co., Honolulu, H. I., was shot and killed, Aug. 11, by another American.

George T. Herbert, a hydraulic engineer of Denver, Colo., died Aug. 3, aged 57 years. He was born in England and went to Denver about 35 years ago. For a number of years he was Manager of the Denver branch of Fairbanks, Morse & Co.

George Lovis Harris, a mechanical engineer of Alameda, Calif., died Aug. 2. He was born at Yarmouth, Maine, 82 years ago. At one time he was Master Mechanic on the St. Petersburg & Moscow R.R. in Russia. During the Civil War he returned to America and served in the U. S. Navy as Third Assistant Engineer under Admiral Farragut. He is survived by a widow and four children.

Charles Simeon Denison, M. Am. Soc. M. E., Professor of stereotomy, mechanism and drawing at the University of Michigan, died recently at his home in Ann Arbor, Mich. He was born in Gambier, Ohio, July 12, 1849. He graduated from the University of Vermont in 1871 in civil engineering. For a year he was Assistant Engineer on construction of the Milwaukee & Northern R.R. Since 1872, he had been a member of the faculty of the University of Michigan. He also served as an astronomer and surveyor with the United States survey party on the boundary between Washington and Idaho. He was a member of the Michigan Engineering Society, the Detroit Engineering Society and other engineering and scientific societies. He was the author of numerous papers, technical articles and lectures. He was unmarried.

ENGINEERING SOCIETIES

COMING MEETINGS

INTERNATIONAL GEOLOGICAL CONGRESS.
Aug. 7-14. Twelfth annual session at Toronto, Ont. General Secy., R. W. Brock, Director of Geological Survey of Canada, Ottawa, Ont.

THE TRAVELING ENGINEERS' ASSOCIATION.
Aug. 12-16. Annual convention at Chicago, Ill. Secy., W. O. Thompson, New York Central Car Shops, East Buffalo, N. Y.

AMERICAN PEAT SOCIETY.
Aug. 18-20. Joint annual convention of the Canadian and American Peat Societies, at Montreal, Can. Secy., Julius Bordollo, Kingsbridge, New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Aug. 18-21. Annual convention at Butte, Mont. Secy., Bradley Stoughton, 29 West 39th St., New York City.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Aug. 19-22. Annual Convention at Watertown, N. Y. Secy., Clarence R. George, Houston, Tex.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.
Sept. 1-4. Annual convention at Cleveland, Ohio. Secy., J. D. Farasey, 37th St., Cleveland, Ohio.

INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS.
Sept. 1-6. Annual convention at New York City. Secy., Jas. McFall, Roanoke, Va.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION.
Sept. 8-12. Annual convention at Chicago, Ill. Secy., L. C. Ryan, Chicago and North Western Ry., Stirling, Ill.

AMERICAN ELECTROCHEMICAL SOCIETY.
Sept. 9-11. The 24th general meeting at Denver. Secy., Prof. Jos. W. Richards, Lehigh University, South Bethlehem, Penn.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 10-12. Annual convention at Philadelphia, Penn. Secy., Willard Kent, Narragansett Pier, R. I.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 9-13. Annual meeting at Colorado Springs, Colo. Secy., S. M. Guma, 755 Boyleston St., Boston.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 9-12. Annual convention at Ottawa, Ont. Secy., A. P. Dane, Reading, Mass.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION.
Sept. 17-18. Tenth annual meeting at Cleveland, Ohio. Secy., W. P. Blair, 824 Engineers' Building, Cleveland, Ohio.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 22-26. Annual Convention at Pittsburgh, Penn. Secy., I. D. Israel, 29 W. 39th St., New York City.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 22-24. Annual meeting at Pitsburgh, Penn. Chairman, H. M. Wilson, 40th and Butler Sts., Pittsburgh, Penn.

The American Institute of Quantity Surveyors—The object of this society, which is in the process of formation in San Francisco, Calif., is "to promote a better method of estimating, and of inviting and receiving bids." It is proposed to establish local councils or committees in all the large cities of the country for the furtherance of this aim. Those interested may secure further information by addressing the founder, G. Alexander Wright, 571 California St., San Francisco, Calif.

City Planning Conference of St. Paul—This organization was recently formed in St. Paul and comprises as charter members the following societies: The Civil Engineers Society of St. Paul; the Gargoyle Club (architects); the Men's Garden Club; the Real Estate Exchange, and the Women's Civic League. There will be seven committees for handling the active work of the club.

American Public Health Association—The 41st annual meeting will be held at Colorado Springs, Colo, Sept. 9-13. The program will be divided into six sections, including the general sessions. The preliminary program of the sanitary engineering section includes papers discussing ventilating methods, water sterilization, and the disposal of city refuse. Rodolph Hering, consulting engineer, New York City, is the president of the Association, and Prof. Selskar M. Gunn, Boston, Mass., is the secretary.

The American Society of Civil Engineers—The Society will hold a meeting, Oct. 15, at New Orleans, La. In connection with this meeting the Louisiana members have arranged a program covering Oct. 15-18. The headquarters will be the Grunewald Hotel. The program, subject to minor changes, is as follows:

Oct. 15—Welcoming addresses by the Governor of Louisiana, the Mayor of New Orleans, and the President of the Louisiana Engineering Society. (2) A talk by a local member descriptive of topographical peculiarities of New Orleans and vicinity, calling attention to technical practice in this territory which by reason of local conditions differs from the standard practice elsewhere. (3) Address on the "Problem of Mississippi River Control." (4) An automobile trip through the city in the afternoon. In the evening there will be a paper entitled "Flood Flows," by Weston E. Fuller, M. Am. Soc. C. E., and an illustrated address on the "Sewerage, Drainage and Water-works of New Orleans."

Oct. 16—In the morning there will be a river trip in New Orleans harbor, with lunch on the steamer. Automobile trip from the steamer to the water-filtration plant, then to a typical drainage pumping station and to other points of engineering interest. In the evening there will be a smoker and entertainment at which the ladies of the party will be welcome.

Oct. 17—In the morning the party will be taken through the old French quarter. In the afternoon a garden party will be given at the Country Club, and in the evening a dinner and dance will be held.

Oct. 18—There will be a visit to Avery's Island salt mines, near New Iberia, La., by special train, with a probable stopover to inspect the large sugar estate.

For those members who may desire to visit the Panama Canal at this time, the local committee will make reservations on a steamer scheduled to sail from New Orleans to Panama on Oct. 18. Should there be a sufficient number to warrant such action the United Fruit Co. will change the sailing date to Oct. 19, thus permitting the completion of the program; or if the applications are sufficient in number a special steamer will be arranged for the party. The regular round-trip rate to the Isthmus and return to New Orleans is $85, though it is possible that a special rate may be obtained.

ENGINEERING LITERATURE

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REVIEWS AND NOTES

Pipe Dreams on the Gulf Stream

POWER AND CONTROL OF THE GULF STREAM: How it Regulates the Climates, Heat and Light of the World—By Carroll Livingston Riker, M. E. New York: The Baker & Taylor Co. Cloth; 6x8 in.; pp. 102; illustrated. $2, net.

"Man can control the climates, heat and light of the world by protecting the warm north-flowing Gulf Stream from the onslaughts of the ice-cold south-flowing Labrador current," according to the assertion of the author of this book. The results of the intellectual labors designed to establish this assertion the author "most respectfully dedicates to him who holds the power to physically control the world, its climates, its heat and its light." The dedication is not to God Almighty, as we begin to surmise, but to "His Royal Highness and Imperial Majesty King George V." With this introduction we hardly need a biography or portrait of the author.

The assumptions upon which all this fabric of pseudo-science rests are stated in the preface somewhat as follows: Ocean currents practically control the interzonal distribution of tropical solar heat, upon which the temperature and climatic conditions of the northern hemisphere depend; terrestrial centrifugal force is the underlying cause of all ocean currents, and as such has heretofore escaped observation; the ocean currents probably control, to an extent, the axial inclinations of the earth in its solar orbit, and thereby the amount of solar heat and light received by the different zones, which seems also to have escaped observation heretofore; the great warm, north-flowing Gulf Stream conveys needed heat to the northern hemisphere, but is met and robbed of it but half way there by the cold Labrador current; and this meeting can be avoided and consequent benefits ensue by controlling the flow of the Labrador current, which is easily possible, as this book will undoubtedly prove. Health permitting, our author assures us in the last line of his preface, he will be in the arena until the world supports his contentions. (May he have a long life!)

Mr. Riker begins his book by a general description of the Gulf Stream, with popular but not particularly impressive figures as to the amount of water it carries and the heat it contains, compared with coal, etc. He next describes the Grand Banks off the southeast coast of Newfoundland, where the ocean bottom is known to have a depth of only a few hundred feet for many miles off shore. Over this plateau flows the cold Laborador current from the north, which meets and dissipates the Gulf Stream, causing the North Atlantic fogs; and the easing up of the currents of the two streams deposits the silt carried by the Labrador current, which has thus built up the Grand Banks. A part of the Labrador current then flows down our North Atlantic coast and is, according to Mr. Riker, responsible for all manner of bad climate, coast erosion and other dolorous results.

We are now prepared to receive our author's grand conception for obviating all these ills. This consists in nothing more than building a jetty from the southeast point of Newfoundland easterly for 200 miles in water only about 300 ft. deep. This jetty would obviously deflect the warm Gulf Stream into deep water around the end of the jetty, while the cold Labrador current, also deflected around the jetty, would immediately sink and pass under the Gulf Stream and be lost forever in the depths of the ocean; and the warm waters of the Gulf Stream would then proceed unmolested to strike terror to the ice accumulations to the very pole itself. A jetty only 30 miles long, we are assured, would modify the climate of the coast from Newfoundland to Cape Hatteras, and modify the rigors of the cold winters; late springs, coastal fogs and the scouring counter currents would be avoided, and open winter harbors would unquestionably be secured north to the St. Lawrence. What a 200-mile jetty would do we leave to the imagination of the reader.

The next step, of course, is the construction of jetty, which at first glance would seem an appalling undertaking. But in this we are mistaken, for the author readily shows us how easily it is accomplished. The essential requirements, he says, is a continuous backbone of rip-rap, as narrow as can be laid—and the silt deposited by the current will do the rest. The time required, he states, is two years to make the surveys and plans, about three years to construct the plant for handling the stone, and within three seasons thereafter the principal construction would be completed, the jetty in use, and the efficiency of the undertaking fully demonstrated! The cost is roughly estimated at $190,000,000.

In a footnote the author assures us that he has "up his sleeve," so to speak, a much simpler plan, which is under investigation. Although not explained in this book we will satisfy curiosity of the reader so far as to give some of Mr. Riker's verbal explanations of this scheme, which is to anchor a huge cable or rope, of about the same specific gravity as sea-water, along the line of the proposed jetty to retard the bottom current and build up a silt jetty entirely without a rip-rap backbone. The cable would lie along the bottom and be kept i position by kedge anchors, which would allow it to rise from time to time as the silt bank was built up under it. This, the author says, would reduce the cost two-thirds or possibly five-sixths, or make the matter of cost a mere bagatelle of $40,000,000.

We have now gotten but half way through the book, but the remainder is an exposition of the author's theories of ocean currents, their causes and effects, which is intended to substantiate the statements made in the earlier part of the book, and is not of so much interest to engineers as the solution of the problem we have presented. Briefly his theory of the cause of ocean currents is a force, which he calls the equatorial force, which is the resultant of the centrifugal force, at right angles to the axis through the poles, and the force of gravity. He says, centrifugal force increases exactly as terrestrial gravity, and consequently so does the equatorial force. The equatorial force is thus exerted more powerfully upon the heavier bottom strata of the ocean than upon the upper lighter strata, and thus forces the lower strata to the equator and the upper strata to the poles. This may not be perfectly clear, but to satisfy himself on that point we cordially recommend the reader a perusal of the book itself.

Other subjects treated in the closing chapters are the other causes of ocean currents, including the different densities of the water at different depths, the dissolved carbonic-acid gas, etc. The causes of the Gulf Stream and the Labrador current are gone into in more detail, and the effects of the proposed jetty is defined more fully. The effects of the winds upon ocean currents, the influence of the Gulf Stream upon the inclination of the earth in its solar orbit and the vertical circulation of the ocean and the atmosphere all come in for discussion as bases for theories, the exact nature of which we leave to the erudite reader.

The subject as a whole certainly has interesting features, and as there are many engineers who as practical scientists like to discuss both terrestrial and celestial engineering problems for mental exercise and amusement, we cordially recommend to them a perusal of this little book. It will furnish the theme for many an animated argument in the off hours in

camp and office—and be about as profitable as those arguments we are told the philosophers of the Dark Ages had as to the number of angels who could rest comfortably on the point of a needle. The text itself is admirably adapted to this purpose, for the author is long on long and complex sentences; 90 to 100 words is a moderate-sized one; and there are many "thuses," "therefores" and "alsos" and hanging participial phrases, whose exact connection is sometimes hard to determine.

The Manufacture and Cost of Liquid Steel

Reviewed by WILLIAM CAMPBELL*

LIQUID STEEL: ITS MANUFACTURE AND COST—By David Carnegie, M. Inst. C. E., assisted by Sydney C. Gladwyn, A. M. Inst. C. E. New York and London: Longmans, Green & Co., Cloth; 6x9 in.; pp. xxv + 520; 252 text illustrations and 10 plates. $7.50, net.

This volume, in addition to covering the usual ground embraced in the standard textbooks on the metallurgy of steel, brings out prominently the various items of cost of the different processes. It presents to the steelmaker and to the advanced student, analyses and costs of the different materials used—iron ore, pig iron, refractories, etc.; the make-up of charges for different kinds of steel; details and cost of construction and plant; methods of assembling steel works' cost, value of labor and cost of living. And in this way the book differs from those with which we are already familiar.

After a section of 50 pages dealing with materials used in steel manufacture, the book is divided into five parts: the Crucible, the Bessemer, the Openhearth and the Electric processes, Costs and Labor.

Part I, on the Crucible Process, shows very clearly the evolution of the crucible furnace and then takes up the manufacture of crucibles. It gives descriptions, operations, output and costs of the various types of furnaces: coke-fired Huntsman and forced-draft types, gas-fired, ordinary and new form Siemens, Dawson Robinson and Pope furnace gas, and oil-fired American furnaces. Then follow chapters on the cost of crucible steel for carbon and high-speed tools, composition of charges and analyses and uses of the steel.

The section is well and clearly written and the illustrations carefully chosen and executed. But here as elsewhere in the book pounds, shillings and pence, tons, hundredweights and pounds are used and this makes reading of costs comparatively slow for all but the British reader.

Under American practice the total cost per ton of liquid steel is given at £12 3s. 7d. for oil-fired furnace and £9 1s. 7d. for gas-fired.

Part II, the Bessemer Process, opens with an interesting historical summary, which includes the following sentence: "The pioneer of the Bessemer process in America and one to whom all steel men would readily award the honor of having very largely contributed to its development and success was Mr. Alexander M. Holley." The author also gives credit to Robert Mushet and F. Goransson, to whom "the commercial success of the process is largely due." "The acid Bessemer Process besides other large steel processes has benefited by the use of the mixer introduced first by Captain Jones at the Edgar Thompson works in 1890, and simultaneously in Germany."

The acid process is first briefly described. Next comes the basic process of Thomas and Gilchrist, with several modifications. Then follows a very interesting description of the evolution of the converter and the design and arrangement of Bessemer plants. British practice is illustrated by the North Eastern Steel Works, Middlesborough; American practice by the Youngstown Steel & Tube Co., German practice by the Burbach Works. Seven chapters are devoted to the cost, composition of charges and analyses of steel in large Bessemer plants, modern two-ton bottom-blown and side-blown converter plants for small steel foundries; also converter plants for small foundries of one ton and less. The cost of producing steel in a 10-ton basic plant with four converters is estimated at £3 6s. 11½d., which is compared with the figures of other authorities viz.: Cost in Germany £3 9s. 3d.—£3 10s. 8½d. with pig iron at £4 1s. 8d. and 33s. 10d.; at Charleroi, Belgium, £2 17s. 5d. The cost in a 24-ton basic plant of four converters is estimated at £3 3s. 6d.

Part III, the Open-hearth Process, briefly describes the acid, then the basic process with its various modifications, the Witkowitz Duplex, the Pszczolka-Daelen, the Bertrand Thiel or Hoesch, the Talbot, the Monel and Rees-James, and the Knoth processes. The development and design of open-hearth furnaces, mixers, gas producers and the arrangement of large plants, the latter exemplified by the Gary plant of the Indiana Steel Co., the Union Steel Company's works at Canton, O.; the Georgsmarienhütte at Osnabrück and the Bethlen-Falvahütte, Germany. The details of costs are set forth and the estimated cost per ton of steel is given at £3 7s. 3d., with five 75-ton basic furnaces to £3 2s. 6d., with three 40-ton basic and £3 1s. 7½d., with two 35-ton basic furnaces. A chapter is devoted to steel production in small openhearth furnaces, with summaries of costs. Then follow chapters on the Talbot Continuous Process; Composition of Charges, Analyses and uses of openhearth steel; the Duplex processes, Bessemer and openhearth, and the Bessemer and electric furnace. This section is very clearly written with no dearth of illustrations and is one of the most instructive in the book.

Part IV, the Electric Process, gives first the evolution of the electric furnace from the first electric furnace used for the manufacture of steel, Siemens' experimental arc furnace of 1879, to the induction furnace of Kjellin introduced in 1900. Then come five chapters dealing with the five types of furnaces—arc, induction, arc resistance, combined arc and resistance and resistance—in which the various furnaces are very well described, in brief, and the output, working costs, etc., given for the principal ones.

This part ends with two short chapters on the chemical reactions and composition of charges, etc. In 58 pages the author gives a clear, concise summary of the principal points of the electric-furnace method for the production of steel.

Part V, of 28 pages, is devoted to Costs and Labor, and embraces comparisons of costs of liquid steel produced (a) by the same process (b) by different processes; system of costs keeping with methods and forms used; comparison of labor and operating costs, wages and cost of living. The figures given in the several tables comparing costs are very instructive and show just where the differences come in (as in table for crucible tool steel where in the ordinary coke furnace the raw materials for carbon tool steel and for grade C high-speed cost £13 3s. 3d. and £150 12s. 10d., respectively) but their accuracy must be left to the consideration of those actively engaged in the manufacture of steel.

The essentials are given for systematic keeping of costs whereby a knowledge of the cost of the various items is obtained without leakage of information to outsiders. Such information will be of great value to the student. To most manufacturers, however, such itemizing of costs is an old story, especially in this country.

Under cost of living and wages it is estimated that in the German engineering and shipbuilding trades the wages paid per hour amount to about 75% of the English rate and the cost of living is nearly 20% higher. The spending power of the British and German steel works laborer is equal to if not slightly better than the American's but melters and so forth are better off in this country than in Europe.

Taken as a whole, the book is a good one, clearly written, well balanced and excellently illustrated. It presents the salient points in the manufacture of steel and at the same time brings out prominently the item of cost in each operation, a most important feature. As such it will appeal to the steel maker and the advanced student.

It should be noted, however, that as a textbook, the volume covers but one phase of the subject—the manufacture of steel—and does not touch on the equally important branches, its application to engineering uses by mechanical treatment or foundry practice and the constitution and heat treatment of steel in general. To the American reader it has the further disadvantage of using a foreign system of weights and coinage.

PORTLAND-CEMENT MATERIALS AND INDUSTRY IN THE UNITED STATES—By Edwin C. Eckel, with contributions by Ernest F. Burchard and Others. Bulletin 522. Washington, D. C.: U. S. Geological Survey. Paper; 6x9 in.; pp. 401; illustrated.

The character of this Government report is best described by the author's preface, where he says:

This report has been prepared in order to give information desired by two classes of persons—owners of lands on which marl, limestone and clay deposits are found, and cement manufacturers, or those who desire to become such.

The writer has attempted to describe the chemical and physical properties which a portland-cement material must have, and above all to show that the value of cement material depends almost entirely upon its location with respect to fuel supply, transportation route and market. For cement manufacturers, present and prospective, who want to know in what localities in a given state or group of states cement materials will probably be found, and who desire information in advance of actual testing as to the physical and chemical characters of the material, a section dealing with the cement re-

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sources of the separate states has been prepared. . A brief sketch of the general status of the portland-cement industry is presented in order to make the subject clear to the great number of people who are interested in one way or another in the conditions and growth of this important branch of manufacture.

Mr. Eckel and his associates have admirably fulfilled their intention, as stated above. The book is a complete guide to the cement resources of the United States and in addition makes a very useful textbook on the fundamentals of cement composition, manufacture and production.

Marine Turbines

Reviewed by D. W. TAYLOR*

BERECHNUNG UND KONSTRUKTION DER SCHIFFSMASCHINEN UND-KESSEL—Ein Handbuck zum Gebrauch fur Konstrukteure, Seemaschinisten und Studierende. Erganzungsband: Schiffsturbinen von Dr. G. Bauer, Direktor der Vulcan-Werke Hamburg und Stettin A.-G., und O. Lasche, Direktor der Turbinenfabrik der AEG Berlin, unter Mitwirkung von Ingenieur E. Ludwig, Abteilungschef der Vulcan-Werke. Second edition, enlarged and improved. Munchen and Berlin: R. Oldenbourg. Cloth; 6x9 in.; pp. xv + 442; 254 text illustrations and 6 folding plates. 15 Marks.

As the title indicates, this is a supplementary volume to a previous work by the same principal author, Dr. Bauer, on the design and construction of marine engines and boilers. It is devoted entirely to marine turbines, which are treated in the elaborate fashion we have come to expect in German technical works. It is to be noted, moreover, that of the three authors associated in this production, two are intimately connected with German turbine construction.

The book opens with a classification of turbines into impulse, reaction and mixed types. It is pointed out that for marine purposes, whatever the make may be, the mixed type is now practically universal. After a few pages on the relative economy, maneuvering power, etc., of turbines and reciprocating engines, 114 pages are devoted to the theory of turbine design and 99 pages to turbine construction, these two chapters constituting the backbne of the book and going comprehensively into their subjects. A succession of short chapters deal with shafting and propellers; condensers and their fittings; typical layouts of various makes; installations on various types of vessels; mixed installations, where turbines use exhaust steam from reciprocating engines; reduction gears; turbine drive for auxiliary machinery; measuring and indicating apparatus; and precautions necessary in operation of turbines to prevent blade stripping and corrosion. The last chapter, of 45 pages, contains a large number of tables, such as conversion tables from English to metric measure; tables of strength of materials; steam tables, and distances in sea miles from the principal German ports to all other ports of the world.

The book covers very fully and satisfactorily the subject of marine turbine design and construction in Germany, where the science and art have been largely developed. The authors consider that direct turbine drive is not applicable to any type of ship having a speed less than 18 knots. They give, however, in Chapter X, descriptions of reduction gears which render turbine drives available for vessels of low speed.

A very excellent description is given of the Foettinger hydraulic reduction gear, which is now being tried with great boldness on a large scale upon several German vessels. The Foettinger reduction gear resembles more than anything else a small centrifugal pump driving a large pump, and hydraulic engineers will note with interest that there is a combined efficiency of about 90% claimed for the combination. This is, indeed, a remarkable achievement, and the service experience of these reduction gears will be followed with interest. The Foettinger design has the drawback of not being available for reductions greater than one to ten, and apparently the largest installation hitherto made provides a reduction of one-fifth only, which is not enough for slow vessels. For such vessels the authors appear to concede that gear wheels such as have been developed by Parsons in England must be used, although they apparently do not believe that the gear wheels can be used for such large powers or with such small losses as claimed by Parsons. Electrical reduction gears, such as have been often advocated and are now being tried on a large scale on a United States collier, are ignored.

The book contains practically nothing about the development of turbines for marine propulsion in the United States, and comparatively little as to developments which are distinctly English. Except for this, it covers the whole ground in a very satisfactory manner, both for the student and the designing engineer, and it is to be hoped that it will not be long before an English translation is available.

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Railroad Accounting

HANDBOOK OF RAILROAD EXPENSES—By J. Shirley Eaton, formerly Statistician, Lehigh Valley R.R.; author of "Railroad Operations: How to Know Them," and "Education for Efficiency in Railroad Service." New York and London: McGraw-Hill Book Co. Flexible leather; 5x8 in.; pp. v + 559. $3, net.

In view of the work about to be undertaken by the government in the valuation of the railways, which is in charge of a board of engineers and most of the details of which will be worked out by engineers, this book is particularly opportune; for it gives the part of railway work with which most engineers are least familiar. While an understanding of railway accounting methods may not be an essential part of a railway valuation engineer's education, it is certainly desirable, and will give him a much broader grasp and appreciation of the figures with which he deals.

Mr. Eaton's book is a clearly written exposition (and in some instances criticism) of the Interstate Commerce Commission's rules for railway accounting. The author states that it has been the intention to "make this compilation a handbook that would be reasonably complete for all the purposes of the operating officer or the railroad statistician and financier." Mr. Eaton has had experience both as a railroad statistician with the Lehigh Valley R.R. and as an author of previous books on railway accounting, so that he would seem eminently qualified to give us the kind of a book he has outlined.

Some 220 pages of the book are divided into eight chapters which take up in logical order: Capital and income accounts, Maintenance-of-way and structures, Maintenance of equipment, Traffic expenses, Transportation, General expenses, Outside operations, Additions and betterments. Each chapter is subdivided into compact paragraphs with bold-faced type headings, so as to do everything possible to bring order out of the chaos, which is all the uninitiated see in the elaborate accounting and statistical analysis of the transportation industry. The following 200 pages are reprints of the Interstate Commerce Commission's rules, abridged and systematically arranged. The remaining 150 pages, nearly one-third of the book, comprise a very complete and thorough index—certainly a most valuable element in such a work.

This brief outline of the contents coupled with the fact that the book is written by an expert and in such clear and concise terms that the whole may be comprehended by any intelligent man will, we believe, make the book attractive to those engineers who are about to undertake the valuation of several billion dollars' worth of railway property in this country. The book should also be valuable to any railway engineer, particularly, of course, the chapters on maintenance-of-way and structures, maintenance of equipment and additions and betterments; since he is the man who spends the money, it is well for him to know how his expenditures are classified.

As the author states, "the scheme of analysis discloses the anatomy of the railroad structure and the physiology of its operations. To the student of the railroad business it is indispensable as a chart that identifies and relates each of the complex processes. Its use is not limited to the accounting staff; every employee, regardless of his department, should be familiar with the scale of operations of which his special duties are but a part."

A TREATISE ON WOODEN TRESTLE BRIDGES and Their Concrete Substitutes, According to the Present Practice on American Railroads—By Wolcott C. Foster. Fourth edition, revised and enlarged. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 9x13 in.; pp. xix + 440; 180 text illustrations and 76 plates. $5, net.

While the construction of wooden trestles is nowhere near as general as it was in 1891, when the first edition of this book was issued, there is still a remarkably large number of such structures being put up every year. Some of these are only temporary while others are of a more or less permanent nature, and as such require a closer attention to details than did their prototypes twenty-five years ago. This caution is exercised in the selection of the timber, the arrangement of the framework, but more particularly in the details of the connections. Mr. Foster's book still contains the standard structures which marked its original appearance, but it has

been added to every year, so that it now represents the latest ideas in the construction of timber trestles. It is particularly useful in the number of detail drawings accompanied by short descriptions of structures which have proved successful.

We regret that we must say that the chapter on concrete trestles is not up to the standard of the rest of the book, although this is one of the features of the new edition. In fact, the chapter on the trestles themselves consists of little more than a description of one kind of structure which was used on one railway, an abstract, at that of a paper presented to one of our technical societies. Part II of the book which is devoted to "Standard Trestle Plans," contains a few descriptions, taken from the engineering press, of some concrete trestles which have been built. There is no theory of the design of such structures nor any complete explanation of their use and adaptability to conditions.

A very complete and valuable bibliography has been added to the new edition.

Lecture Notes on Compressed Air

Reviewed by C. R. RICHARDS*

AIR COMPRESSION AND TRANSMISSION—By H. J. Thorkelson, Associate Professor of Steam and Gas Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii+207; 143 text illustrations. $2, net.

It is difficult, if not impossible, to prepare textbooks which fully meet the requirements or represent the ideals of all college instructors, and most of us, therefore, present many of our courses of instruction with the aid of lecture notes. In these days of extensive book-making, it is natural that publishers should eagerly seek and issue treatises which were originally prepared and presented as lectures by their writers. When such notes are carefully revised and edited the resulting treatise may be admirable, but unless the completed book contains new matter, or presents old matter in a new way, or develops the subject in a more logical fashion than has previously been done, there is little excuse for its publication.

The inception of Professor Thorkelson's book on "Air Compression and Transmission" is evident, without the note in the preface stating that "the material offered consists of notes used for a number of years by the author in his classes," for it is largely a compilation of information abstracted from a number of well known treatises and technical journals. Nearly one-third of the book is made up of extended quotations, as, for example, the chapter on "Air at Low Pressures," a lecture delivered by H. de B. Parsons at Columbia University; the discussion of turbo-compressors from the article by Franz zur Nedden in the "Engineering Magazine"; air compression at altitudes above sea level, from Peele's "Compressed Air Plant"; and the measurement of air and its transmission, from papers by Professor Thomas and others.

The fifteen chapters into which the book is divided include more or less complete discussions of such topics as fundamental definitions, the thermodynamics of air compression and expansion, air at pressures below the atmosphere and at low pressures above the atmosphere, piston compressors, the several efficiencies of air compressors, multi-stage, turbo and hydraulic compressors, the effects of altitude, air measurement and transmission, and the selection and care of compressors. Three appendices present tables of common and hyperbolic logarithms and a brief discussion of hygrometry. The treatment of some of these subjects is excellent and of others is entirely inadequate. The discussions of volumetric efficiency and efficiency of compression, of multi-stage compression and much of the discussion of the thermodynamics of air are well presented; the treatment of the chapters devoted to valves and valve gears, types of compressors, governors and unloading devices, and on air transmission, reheating, aftercooling, etc., leave much to be desired. For students' use the value of the book would be enhanced by the addition of a chapter on the applications of compressed air.

Many records of suspended matter in streams receiving mine wastes are included in the report of the Sludge Abatement Board of Victoria for the year 1912 (Melbourne, Victoria, Australia). Under the Victoria Mine Act of 1907, water or sludge from mining operations, discharged into any watercourse, lake or reservoir, are deemed to pollute or injure the same, if they contain more than 800 grains per Imp. gal. of earthy or mineral substances in suspension or solution, or more than 50 grains per Imp. gal. of "poisonous matter," or any "noxious matter" in such quantities to be injurious or detrimental to the public health. It is somewhat amusing to find recorded on page 20 a water analysis (in terms of nitrogen contents—albuminoids, ammoniacal and nitrates) resulting from a complaint that a "domestic water-supply was polluted by a carcass of an animal that had been thrown down the air-shaft which connects with the tunnel where the sample was obtained." From this distance it seems as though it would have been simpler to have looked for the remains of the animal. An interesting feature of the report is a considerable collection of reproductions of photographs showing methods and results of disposing of mining sludge, designed to prevent injury to agricultural land. In one instance cited in the text where dredging operations for gold (apparently) are being carried on, great pains were taken to remove the top soil from the basis of mining operations and deposit it carefully on the waste dump, so that crops could be raised immediately.

RIVER AND CANAL ENGINEERING—The Characteristics of Open Flowing Streams and the Principles and Methods to be Followed in Dealing with them. By E. S. Bellasis, M. Inst. C. E., recently Superintendent Engineer, Irrigation Branch, Public Works Department of India. London, England: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 6x9 in.; pp. x+215. 72 text illustrations. $3.50.

Under the definition of the author this book applies to all streams flowing in open channels, so that it is not necessary for him to distinguish between natural and artificial streams in the characteristics of their regulation, except in occasional instances. The subject is a very large one, which would require for its complete treatment much more than the small book which has been allotted to it. For a comparatively brief résumé, however, Mr. Bellasis has succeeded very well.

The book starts with a chapter upon the method of collecting information concerning streams, followed with a chapter on rainfall, which describes how rainfall statistics can be used. The next chapter explains the nature of silting and scouring, and the next, how silting and scouring may be under some circumstances artificially induced or retarded. This completes five chapters.

Chapter 6 deals with various methods of protecting banks against erosion or damage; Chapter 7, diversions or the opening up of new channels, or the opposite of this, the closing of channels. Chapter 8 touches the subject of the training of streams, and Chapter 9 deals with artificial channels of earth or masonry, including navigation canals. Chapters 10 and 11 take up the chief masonry work connected with river or canal regulation, treating this subject only in a general way and leaving the special design of structures for other books on the subject. Chapter 12 discusses storm waters and river floods, their prevention and amelioration, and Chapter 13 takes up the design of reservoirs and dams, the latter in only the briefest fashion. The final chapters deal with tidal waters, river mouths and estuaries, and works in connection with them, etc.

The author has spent most of his professional life in the irrigation branch of the Public Works Department of India, particularly in the famous canals of the Punjab; so naturally his book is colored with his own experience. However, this experience was about as good as any engineer could get in the subject at hand, so that the illustrations which he takes of Indian practice are nearly always apropos and illuminating.

ECONOMICS IN BRICKYARD CONSTRUCTION AND OPERATION—By Ellis Lovejoy, Ceramic Engineer. Indianapolis, Ind.: T. A. Randall & Co. Cloth; 6x8 in.; pp. 72. $1.

Clay as a material of construction is worthy of some little study by every engineer, for brick and drain tile are elements in a great variety of engineering construction work, and it is an axiom that an engineer is the better off in knowing something of the origin of his materials. The substance of the little book before us was printed serially in the "Clay Worker" and its purpose is to bring out points in brickyard construction and operation which are frequently overlooked and lead to waste and loss. The book is compact and very much to the point, and while it is intended for managers and operators of brick works, it gives accurately and concisely the whole process of clay working to get the best possible results. As such it should make a useful reference book in any engineer's library.

In the "Proceedings of the American Railway Association" (75 Church St., New York City), reporting the session of May 21, many pages are devoted to a description of the new rules for railway-track scale and specifications for their construc-

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tion and installation which have been under consideration by a special committee of the Association for some months in coöperation with the Bureau of Standards. The report states that something like 1500 railway-track scales are annually sold in the United States, and that a single-track scale on which coal cars were weighed, in a life of 38 months weighed 1,323,556 cars, carrying over 60,000,000 tons of lading, valued at more than $90,000,000.

A German Text on Machine Drawing

Reviewed by PROF. WINSLOW H. HERSCHEL*

DAS MACHINEN-ZEICHNEN. Begründung und Veranschaulichung der sachlich notwendigen zeichnerischen Darstellungen und ihres Zusammenhanges mit der praktischen Ausführung—Von A. Riedler, Professor an der Kgl. Technischen Hochschule zu Berlin. Zweite, neubearbeitete Auflage. Berlin, Germany: Julius Springer. Cloth; 8x11 in.; pp. vii + 234; 436 text figures. 10 Marks.

Drawing is the language of designers and cannot be understood without some knowledge of shop methods. The German student has no college shopwork and his required practical work comes just before graduation. In Prof. Riedler's opinion, the student should take his year of practical work just after the Freshman year, and he would thus avoid having to study machine drawing before having any experience with machinery.

Taking up the subject from this point of view, Prof. Riedler aims to counteract the student's lack of experience in a machine shop by instructing him about the subjects which lie on the boundary between drawing and machine design. Thus the book includes many things not usually found in books on drawing. There are the usual chapters on sketching, shop drawings, sections and assemblies, but the emphasis is always on the practical purpose of drawings, which is to convey information rather than to show the draftsman's skill in penwork.

It is clearly shown by examples, both of what is good and what is bad, that a drawing must have only one possible meaning, clearly expressed. Fig. 263, drawn in accordance with a common rule not to place any dimension on the figure, is given as an example to avoid, as is also Fig. 300, in which every conceivable dimension is given except the necessary diameters. Examples are given of superfluous shading, and of hidden lines that confuse rather than help. In assemblies in section, clearness is gained by stopping the sectioning just short of the border lines. The importance of a regular system of projection is emphasized by examples of loss due to confusion of right- and left-handed parts. The Germans use first-angle projection, but Prof. Riedler considers the "American system" simpler. With the exception of screw threads, dimensions are always in millimeters, so that the unit does not have to be stated.

Coming now to the chapters on machine design, a multitude of little mistakes are pointed out that are apt to be made by a student who is ignorant of shop processes, or who does not have in mind how a part is to be made. Examples are given of pieces expensive to make because drawn without regard to foundry practice or convenience in machining. Other chapters take up the methods of designing parts so that they may be readily assembled, standardized and manufactured in quantity. These chapters on machine design are the most valuable because they give information most difficult to find elsewhere.

The book is thoroughly practical and to the point. The method of showing examples of bad as well as of good practice is very effective, and anyone would be sure to derive much benefit from a perusal of the illustrations alone.

THE THEORY OF LOADS ON PIPES IN DITCHES, and Tests of Cement and Clay Drain Tile and Sewer Pipe—By A. Marston and A. O. Anderson. Bulletin 31. Ames, Iowa: Iowa State College of Agriculture and Mechanic Arts. Paper; 6x9 in.; pp. 181; illustrated.

The engineering-experiment station of the Iowa State College of Agriculture and Mechanic Arts has been engaged for some time in an investigation of drain tile and sewer pipe made both of clay and of concrete. The section of country served by the experiment station is one of the largest users of drain tile in the United States, so that it is highly desirable for local purposes if for no other that some more definite information be had regarding the design, laying and testing of these widely used aids to better farming.

The report before us takes up first various failures of drain tile and of sewer pipe which have been reported to the authors, analyzes the failures and notes certain methods which would lead to better construction. There then follows a theory of loads on pipes in ditches, taking up the various factors that affect the transmission of the load to the pipe; such factors as tamping, methods of loading, material used in loading, flooding of the ditches, effect of weather and time, etc. The next section describes the test of actual loads of pipes in ditches and the effects resulting therefrom, and this is followed by a section on standard methods of testing in the laboratory, with descriptions of the various kinds of testing machines. The final portion of the bulletin contains some tentative specifications for tile, sewer pipe and pipe laying.

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Choride of Lime for Water, Sewage and General Disinfection

CHLORIDE OF LIME IN SANITATION—By Albert H. Hooker, Technical Director, Hooker Electrochemical Co. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; v + 231. $3.

The origin of this volume was a decision on the part the research department of the company with which the author is connected "to collect all data relating to the uses of chloride of lime in sanitation." The material having been collected, it was grouped under various headings, abstracted in condensed form and prefaced by some eighty pages of what may be termed editorial summary and comment.

The editorial section opens with a brief history of the manufacture of chloride of lime, which is followed by sections on the use of this chemical as a disinfectant in water and sewage treatment, street sprinkling, epidemics, surgery and general sanitation, on the farm, and in the campaign against flies. The "Abstracts and References" run to 442 entries, grouped under about sixty heads. Many of the references appear to be given over and over under different headings and some of the headings are virtual repetitions. The abstracts generally run from a few lines to a page or so, but a few of them are several pages in length.

The editorial summary and preface is largely an argument or brief for the wide use of commercial chloride of lime (bleaching powder or hypochlorite of calcium) as a disinfectant and contains some of the one-sided or partial statements common to special pleading and trade catalogs.

The abstracts and references will be a convenience to those who wish to pursue the literature of the subject. Their usefulness would have been much increased by a more systematic classification, by further condensation in some cases, by less virtual if not actual repetition, and by at least a city index to the water and sewage treatment plants included in the abstracts.

It should be noted that the book does have an index of persons named throughout, and of the editorial summary, as well as a table of contents which gives the sixty subheadings of the abstracts and references.

REINFORCED CONCRETE WALL FOOTINGS AND COLUMN FOOTINGS—By Arthur N. Talbot. Bulletin 67. Urbana, Ill.: University of Illinois. Paper; 6x9 in.; pp. 114; illustrated. 50c.

In the five years from 1908 to 1912, inclusive, the laboratory of Applied Mechanics of the University of Illinois, under the direction of Prof. Talbot, made long series of tests on the behavior of reinforced-concrete footings both for walls and for columns under loads producing ultimate failure. This subject is one of great interest to designing engineers and one on which they have had up till now very little experimental information.

The tests were made in the characteristic thorough manner of the University of Illinois laboratory and have been explained in the similar thorough manner of Prof. Talbot's well known testing bulletins. While, as stated in the bulletin, there are some gaps yet to be filled in the theory deduced from the test that theory is of sufficient extent to be of great aid to designers of footings and the behavior of the footings tested when studied thoroughly will enable a designer to alter or check, as the case may be, his own theory.

WRIGHT ON BUILDING ARBITRATIONS—A Manual for Architects, Students, Contractors and Construction Engineers—By G. Alexander Wright, author of "Wright on Quantities." San Francisco, Calif.: The Author, 571 California St. Paper; 6x9 in.; pp. 48; by mail, $1.

The desirability of submitting to an independent and nonlegal arbitrator disputes which arise in the execution of building contracts is undeniable, and the delay, expense and unsatisfactory decisions which often result from a Court settlement of such disputes have led many contractors and owners

to the use of the independent arbitration method. The booklet which is noted above, a second edition of the one which first appeared in 1894, is in brief a discussion of the merits of the arbitration system and the manner in which such arbitrations should be conducted. In addition it contains a number of blank forms which can be used by arbitrators in the pursuance of their duties.

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German Books on Building and Bridge Construction

Reviewed by LEON S. MOISSEIFF*

LEHRBUCH DES HOCHBAUES—Edited by Esselborn. In Two Parts. Vol. 1, Steinkonstruktionen und Grundbau. Holzkonstruktionen. Eisenkonstruktionen. Eisenbetonkonstruktionen. Veranschlagen. Baufuhrung. Beleuchtungs- Heizungs- und Andre Anlagen. By E. Beutinger, B. Kossmann, G. Ruth, H. Steinberger, R. Weder. Paper; 8x11 in.; pp. xxiii+897; 2500 text figures. 36 Marks.

DER BAU DER WOLKENKRATZER; Kurze Dartstellung auf Grund einer Studienreise für Ingenieure und Architekten —By Otto Rappold, Regierungsbaumeister in Stuttgart. Muenchen and Berlin: R. Oldenbourg. Cloth; 6x9 in.; pp. viii+263; 307 text illustrations. 12 Marks.

BRUECKEN IN EISENBETON—Ein Leiftfaden für Schule und Praxis. By C. Kersten, Oberingenieur und Oberlehrer a. D. Teil II: Bogenbruecken. Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. viii+236; 504 text illustrations. 6.20 marks.

Esselborn's Treatise of Building Construction has been well known to German builders in recent years. The publication of a revised and much enlarged second edition of the first part indicates its well deserved popularity. The new volume treats of all structural work required for a modern building. Chapters are devoted to foundations, stone, timber and steel construction, estimating, building superintendence and lighting, heating and other installations. The chapters are written by specialists on the various subjects and are treated in a simple, clear manner, giving a full exposition of the matter and in keeping with uptodate modern practice.

Attention may be called especially to the chapter on the preparation of estimates, which treats of the various methods used and contains a well worked out full estimate of a building, and the chapter on building superintendence. The latter gives the complete routine of the prosecution of the work, methods used, records to be kept, measurements to be taken and precautions and protection to be observed.

Of another kind is Rappold's book on the Construction of Skyscrapers, which the Germans, with ever present desire for exactness, have rendered into "cloudscrapers." The author has traveled in the United States and has made studies of the design, construction and erection of our high buildings These he describes in his book. He has produced a book of interest to an engineer.

The German engineers interested in our skeleton construction of high buildings will find all that they need to acquaint themselves with the methods used in erecting these structures.

Foundations, steel, frame and details, protection against corrosion and fire, floor construction and partitions, transportation of building materials and passenger service. all receive due consideration. The book is well written and well gotten up.

Kersten's books on reinforced concrete have earned a good reputation among practicing engineers. Of his work on Reinforced Concrete Bridges, the second volume has now been published in a third newly reworked and enlarged edition. It treats of arches, and is a thoroughly practical book with numerous illustrations of existing structures representing more recent practice. It presupposes in the reader a knowledge of the general theory of bridge design in as far as it applies to arches. The book is intended to supplement the existing works on bridge construction, and it more than fulfills its promise. It is an excellent little book for the practical design of ordinary arches. The author works out a number of numerical examples covering various types of arches.

Altogether the three books noted are good samples of thorough work.

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A number of short recent addresses on various sanitary and health phases of the public ice supply have been published as separate pamphlets or leaflets by the Natural Ice Association of America (116 Nassau St., New York City). Among the authors are Wm. T. Sedgwick, Edward O. Jordan, Geo. C. Whipple, C.-E. A. Winslow and H. W. Hill. As might be expected, the authors are unanimous in their opinion that ice plays a very small part in the spread of disease.

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THE MOTOR AND THE DYNAMO—By James Loring Arnold, Professor of Electrical Engineering, New York University. Easton, Penn.: Chemical Publishing Co. London: Williams & Norgate. Cloth; 6x9 in.; pp. v+178; 166 illustrations. $1.50.

The author states that this work is intended "to present the essentials of electrical science," embodying the substance of laboratory conferences and lectures, but discussing only modern machinery. It would have been more accurate to say that the author has presented the rudiments of theory in the design of the simpler apparatus with some superficialities of construction and operation of some more complicated machines. For instance, he gives equations for voltage generation in a direct-current generator or motor, shows how the magnetic circuits are proportioned, and adds a little on armature circuits. Then he takes up some features of mechanical arrangements and passes on to laboratory testing for proper connections, insulation and performance characteristics. Then he hurriedly takes up some of the makeshifts used to secure a variable-speed motor for industrial service—field control, interpoles, multiple-voltage control (each of which is not exactly simple as worked out by their designers) before cataloging the fields of motor uses. The last part of this section on direct-current machines describes the segregation of the several losses in machines and the tests for efficiency by power-loss measurements. It should be noted perhaps that a mathematical exposition of magnetic and electrical phenomena at first introduced the student to dynamo machinery.

The rest of the volume (about 40%) deals with alternating currents. There is at the start a good but unnecessarily long presentation of the derivation of sine waves and the reason why alternating e.m.f. curves have this shape. This is followed by really elementary matter on the properties of alternating-current circuits and on phase relations of currents, voltages, etc. Then the author goes on to less elementary ideas, but with the superficiality already noted—telling of Tirrell regulators, split-pole converters, transformers and induction-motor starters, though these are interspersed in some really elementary discussions of measuring instruments, alternator-voltage regulation, synchronous motors, generators in parallel, rotary converters and induction motors.

The book is interesting and useful though necessarily not novel. The style is clear though the pages are marred by numerous typographical errors. The line cuts are clear but mostly not as artistic as in some of the other books of similar scope. The halftones evidently are made from catalog electrotypes.

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ELECTRIC INTERLOCKING HANDBOOK—By the Engineering Staff of the General Railway Signal Co. Rochester, N. Y.: (Henry M. Sperry, Editor). Limp leather; 4x7 in.; pp. 435; 284 illustrations and text figures. [Free to railway men at the discretion of the company; $3 to all others.]

Although this book is issued by a manufacturing company and deals with systems and apparatus which are this company's specialties, it is far from being merely an illustrated catalog. It is largely descriptive of the various railway interlocking switch and signal systems, mechanism and apparatus within its scope, and it covers also the matters of installation and maintenance. It is profusely illustrated by halftone and line engravings, many of the former showing actual installations. About 110 pages are devoted to a variety of information in regard to batteries, wires, track weights of materials, etc., together with specifications of the Railway Signal Association for signal aspects, symbols (for use on drawings), wiring, batteries and concrete. All this is information which is constantly required by signal engineers and the men in the signal departments of railway companies.

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PATROLMAN'S MANUAL; CITY OF PHILADELPHIA—Compiled by George D. Porter. Philadelphia, Penn.: Department of Public Safety. Cloth (flexible); 4x7 in.; pp. 231.

This is a pocket manual compiled and issued under the direction of Mr. George D. Porter, Director of the Department of Public Safety. It is intended for ready reference by members of the police force to inform them as to their duties and as to the main features of the laws with whose enforcement they are intrusted. Mr. Porter states that when he assumed office under the present city administration of Philadelphia, he found that the duties of patrolmen were not

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outlined in writing and that many police officers were handicapped in their work because of lack of knowledge as to what their duties were. The manual may be found useful by engineers who have to do with the organization of police forces in connection with public works or under a municipal government.

State Railway Ownership in Australia

THE STATE RAILWAY MUDDLE IN AUSTRALIA—By Edwin A. Pratt, author of "A History of Inland Transport and Communication in England," "Railways and Nationalization," "Irish Railways," etc. London: John Murray, 50A Albemarle St., W. Cloth; 5x8 in.; pp. viii + 164. 2/6, net.

The title which the author has chosen for his book gives a most admirable idea of its contents. By it the reader is notified that the author considers state-railway ownership in Australia a miserable failure, and his book is an attempt to demonstrate this. So far as may be judged from the contents of the book, its author has made no investigation in Australia at all. Apparently his knowledge of Australian railways is chiefly gleaned from Australian newspapers and other publications.

It would not be difficult to frame an overwhelming indictment of the railways of any country, under whatever management, simply by making well chosen extracts from the files of current newspapers. The different counts in the indictment which the author brings against the Australian railway system are contained in the several chapter headings, some of which are mentioned immediately below. The second chapter is entitled "Shortage of Trucks," or translated into the American vernacular, car shortage. The two following chapters are devoted to the grievances of fruit growers on account of delays in transportation and delivery. According to the author's own statement, however, a large part of the fruit-growers' complaints are due to the fact that considerably more is produced than the markets can possibly absorb. In "Treatment of Live Stock," the railways are condemned for not being more humane in the transportation of live animals. Some of the titles of following chapters are: "Shortage of Tracks," "Traffic Concentration on Capitals," "Difference of Gage," "Passenger Service," "State Railways and Industrial Development," "State versus Company Management," "State Railway Finance."

One turns to this last-named chapter expecting to find at least a summary of the existing financial situation of the Australian railway system. The general tone of this chapter, however, is just like the others. The author opens with the sentence "To try to get at the real financial position of the Australian state railways would be an almost hopeless task." There is no evidence, however, that the author has made any particular endeavor to perform this task.

If the British railways are depending on such partisan arguments as the book before us to offset the current tide in England setting toward the nationalization of the railways, their condition is indeed pitiable. We do not at all doubt that the influence of politics in the Australian State railway system has greatly hampered its efficiency; but if its defects are to be presented to the public in a convincing way, some less partisan writer than the author of this book should be selected.

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES; Gas Statistics (1913)—Compiled and corrected annually by E. C. Brown. New York: "The Gas Age." Cloth; 7x11 in.; pp. xxxii+768. $5.

It is a pleasure to find in the present issue of this well known and useful Directory a brief summary of its contents, company and city indexes, and a directory of 28 public service commissions having control of lighting companies. The volume also contains, besides the usual information as to gas works, high and low prices for gas securities in 1912, and nearly two hundred pages of "data in detail of sundry gas and gas-electric corporations." There are listed in the volume the following number of "companies" (private and municipal works): Artificial gas, 1108; natural gas, 602; acetylene, 301; gasoline, 114. This makes a total of 2025 "companies," not counting 123 "parent companies."

CONTINUOUS BEAMS IN REINFORCED CONCRETE—By Burnard Geen, A. M. I. C. E. London, England: Chapman & Hall, Ltd. Cloth; 9x11 in.; pp. 210; 71 diagrams and text figures; 9s., net.

That part of the book noted above which is devoted particularly to the computation of stresses in continuous beams may be found quite valuable by those engineers who are interested enough in the precise analysis of concrete structures to determine the complete effect of continuity and of rigidity. The book, however, is overburdened with some 80 pages (8½x11 in.) of moment and shear diagrams, through which it is hardly believable anyone will attempt to wade.

A Reading Course in Electrical Science

PRACTICAL ALTERNATING CURRENTS AND ALTERNATING-CURRENT TESTING—By Charles F. Smith, M. Sc. M. I. E. E.; M. Inst. C. E. Fifth Edition. Manchester, England: Scientific Publishing Co. Leatherette; 6x9 in.; pp. xv + 398; 258 text figures; 6s., net.

To many American teachers, this book will appeal as the embodiment of how not to teach natural science. That is, the author presents a bit of theory and then follows it with an outline of experiments to illustrate and verify the law or show the phenomenon giving details of apparatus, arrangement of readings, working up of data and finally readings and curves from a real experiment.

It is probably true that this sort of laboratory instruction largely discourages that development of ability for original thinking which is so greatly needed in engineering work. Yet, we cannot help feeling that this book is not so much intended for an experimental guide as for a sort of readers' course with pen pictures of the demonstrations that would naturally accompany lectures.

The author, it is noted, in this latest edition, has failed to change his text in one way which now becomes especially important; by universal agreement the vector diagrams, which are so necessary in graphically explaining alternating-current relations, are now being drawn for counter-clockwise rotation, but the author has stuck to the clockwise figures. This is sure to confuse electrical students of the next generation who, unlike the present ones, will not be initiated into both types of diagrams.

The generation of e.m.f., harmonic changes, sine waves, properties of circuits, power, power factor, and the addition of vectors (all involving the measurement of "effective" voltage) and experiments involving the use of voltmeters are given before explaining which one of the several values of potential (average, root-mean-square, or maximum) such instruments show. This question is almost sure to rise early in the readers' mind, but the answer is deferred for 73 pages.

Otherwise the book is good; the presentation is clear and concise and the matter included sufficient to cover the fundamental actions in alternating-current apparatus together with the more important modifying and complicating phenomena. Naturally there are a few slight differences between the author's (British) nomenclature and our American usage, but these are very minor items.

The author differs from most of his contemporary teachers of electrical engineering in that he does not present the design of apparatus as a road to knowledge of the science; instead he confines himself to the electrical and mechanical reactions involved.

The first apparatus discussed after the more general and basic matters are disposed of is the transformer; after this comes the alternator, synchronous motor, rotary converter, induction motor and single-phase motor, with a final chapter, as a sort of appendix, on analysis of voltage waves.

THEORY AND TEST OF AN OVERSHOT WATER WHEEL—By Carl Robert Weidner, Instructor in Hydraulic Engineering, University of Wisconsin. Bulletin 529. Madison, Wis.: University of Wisconsin. Paper; 6x9 in.; pp. 136; 33 plates and text illustrations. 40c.

The tests presented in this bulletin formed the basis of a brief article in "Engineering News," Jan. 2, 1913, p. 38, and showed that under the same conditions (as when the power was comparatively small and the load widely varying) this old type possessed inherent advantages. The author has included a translation of part of Prof. C. Bach's (Stuttgart) "Die Wasserräder," on the design of overshot wheels.

"Rat Proofing," as applied to the construction and repair of buildings, is described by Dr. Friench Simpson in Public Health Reports for Apr. 11, 1913 (U. S. Public Health Service, Washington, D. C.). A number of halftone views show how to exclude rats from buildings and how to favor their introduction.

A large three-volume work entitled "The Coal Resources of the World," edited by the Geological Survey of Canada, is announced. The work is published by Morang & Co., Toronto, Canada, at $25 a set. There will be three quarto

volumes of about 400 pages each, and an Atlas of 66 pages of colored maps, the Atlas being 14½x19½ in., bound in heavy paper cover. The work is the result of an inquiry made upon the initiative of the Executive Committee of the Twelfth International Geological Congress, held in Canada in 1913.

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INSKIP'S TABLES—Fourth edition, enlarged. Philadelphia, Penn.: G. D. Inskip, 6728 Leeds St. Leather (flexible), 5x7 in.; pp. 600; illustrated. $3, postpaid.

The fourth edition of Inskip's well known tables contains several additions in the hip and valley framing tables, and has the first eight pages of tables of squares and logarithms, which are most apt to be used, printed on cloth. It still remains one of the best sets of tables for the use of the draftsman or designing engineer.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN MINING CONGRESS—Proceedings of Fifteenth Annual Session. Denver, Colo.: J. F. Calibreath, Secretary. Paper; 6x9 in.; pp., 261.

BEIHEFTE ZUM GESUNDHEITS-INGENIEUR—Reibungs- und Einzelwiderstande in Warmwasserheizungen. By Dr. Techn. K. Brabbée, Professor an der Kgl. Technischen Hochschule zu Berlin. Munchen and Berlin: R. Oldenbourg. Paper; 8x11 in.; pp. 52; 104 text illustrations and 10 folding tables. 8 marks.

BIBLIOGRAPHY OF SMOKE AND SMOKE PREVENTION. Compiled by Ellwood H. McClelland, Technology Librarian, Carnegie Library of Pittsburgh. Bulletin 2, Smoke Investigation. Pittsburgh, Penn.: Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburgh. Paper; 6x9 in.; pp. 164.

A BONUS SYSTEM FOR THE PURCHASE OF PORTLAND CEMENT—By W. C. Reibling, Division of General, Inorganic and Physical Chemistry. Reprinted from the Philippine Journal of Science, published by the Bureau of Science of the Philippine Government, Manila, P. I. Paper; 7x10 in.; pp. 18.

CITY OF JERSEY CITY, N. J.—Report of Suggested Plan of Procedure for City Plan Commission—By E. P. Goodrich and George B. Ford, and Addenda Memoranda to Report. Two Pamphlets. Paper; 7x10 in.; pp. 64 and 33, respectively.

CONCRETE ROADS AND PAVEMENTS—By E. S. Hanson, Editor "The Cement Era"; author of "Cement and Tile." Chicago, Ill.: The Cement Era Publishing Co. Cloth; 5x8 in.; pp. 227; numerous illustrations. $1.

THE CURRENTS IN THE ENTRANCE TO THE ST. LAWRENCE. From Investigations of the Tidal and Current Survey in the Seasons of 1895, 1911 and 1912. Ottawa, Canada.; Department of the Naval Service. Linen; 7x10 in.; pp. 50.

ELEKTRISCHE KRANAUSRUSTUNGEN DER SIEMENS-SCHUCKERTWERKE—Teil I, Montoren und Apparate, Berlin, Germany; Julius Springer. Cloth; 7x10 in.; pp. 74; numerous illustrations. 3 marks.

The electric cranes manufactured by the German works named in the title to this book are described in technical detail. The motors are first taken up, then complete installations. Numerous well executed line drawings and halftones add to the interest and value of the work—which is considerably more than a trade catalog. A brief history of the works is given. The modest price brings the book within the reach of all who may be interested.

THE ELEMENTS OF SPECIFICATION WRITING—A Text-Book for Students in Civil Engineering. By Richard Shelton Kirby, Professor of Civil Engineering, Pennsylvania College. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. vii + 125; $1.25, net.

ENGINEERING TABLES AND DATA—By W. W. F. Pullen, Assoc. M. Inst. C. E. Third Edition. Manchester, England: Paper; 5x8 in.; pp. 68; illustrated: ½ net.

For use in the laboratory or testing room. Contains steam tables, tables of the circular measure of angles, common and hpperbolic logarithms, trigonometric tables and formulas, hyperbolic functions and standard differentials and integrals; tables giving the density and volume of water, the density, specific heat, coefficient of expansion and melting point of metals, the thermal conductivity and radiation of metals. There is a steam dryness chart for use with throttling calorimeter; a sulphur dioxide chart, an ammonia chart and a carbonic-dioxide chart.

ESTADO ACTUAL Y PORVENIR DE LA INDUSTRIA PETROLIFERA EN EL PERU—By Ricardo A. Deustua. Lima: Ministerio de Formento, Cuerpo de Ingenieros de Minas del Peru. Paper; 7x10 in.; pp. 93; 29 text illustrations and 2 folding maps.

FIRST SERIES OF COAL-DUST EXPLOSION TESTS IN THE EXPERIMENTAL MINE—By George S. Rice, L. M. Jones, J. K. Clement and W. L. Egy. Bulletin 56. Washington, D. C.: Department of Mines, Joseph A. Holmes, Director. Paper; 6x9 in.; pp. 115; illustrated.

HANDBOOK ON WIRELESS TELEGRAPHY: ITS THEORY AND PRACTICE, for the Use of Electrical Engineers, Students and Operators—By James Erskine-Murray, M. Inst. E. E., Consulting Engineer of Wireless between Canada and Great Britain. Fourth Edition Revised and Enlarged. New York: D. Appleton & Co. Cloth; 6x9 in.; pp. xvi + 442; 80 illustrations and text figures; $3, net.

HARBORS AND DOCKS—A List of Books and References to Periodicals. Seattle, Wash.: Public Library. Paper; 5x7 in.; pp. 40.

IRRIGATION WORKS: The Principles on Which Their Design and Working Should be Based, with Special Details Relating to Indian Canals and Some Proposed Improvements—By E. S. Bellasis, M. Inst. C. E., Recently Superintending Engineer in the Irrigation Branch of Public Works, Department of India. London, England: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 5x9 in.; pp. 195; 37 illustrations and text figures; $2.50, net.

MARYLAND STATE DEPARTMENT OF HEALTH—Report of the Bureau of Sanitary Engineering, June-December, 1912. Baltimore, Md.; Dr. John S. Fulton, Secretary of Department. Paper; 6x9 in.; pp. 50.

THE NICKEL INDUSTRY: With Special Reference to the Sudbury Region, Ontario—By A. P. Coleman. Ottawa, Canada: Department of Mines. Paper; 7x10 in.; pp. 206; illustrated.

PHILIPPINE COMMISSION—Report for 1912. Washington, D. C.: War Department. Cloth; 6x9 in.; pp. 274; illustrated.

RAILROAD AND WAREHOUSE COMMISSION OF ILLINOIS—Report for Year Ended June 30, 1912. Vols. I and II. Springfield, Ill. Limp leather; 6x8 in.; pp. 573 and 531, respectively; 30 illustrations.

RAILWAYS IN INDIA—Administration Report for 1912 by the Railway Board, Simla, India. Paper; 8x13 in.; pp. 534.

THE REDUCTION OF DOMESTIC FLIES—By Edward H. Ross, author of "The Reduction of Domestic Mosquitoes" and "The Prevention of Fever on the Suez Canal." Philadelphia, Penn.: J. B. Lippincott Co. London, England: John Murray. Cloth; 6x9 in.; pp. viii + 103; 19 illustrations; $1.50, net.

THE RESISTANCE OF THE AIR AND AVIATION—Experiments Conducted at the Champ-De-Mars Laboratory. By G. Eiffel, Past President of La Societe des Ingenieurs Civils de France. Second edition, revised and enlarged. London, England: Constable & Co., Ltd. Boston and New York: Houghton Mifflin Co. Cloth; 10x12 in.; pp. xvi + 242; 124 illustrations and text figures, 27 folding plates; $10, net.

ROCK ASPHALTS OF OKLAHOMA AND THEIR USE IN PAVING—By L. C. Snider. Circular 5. Norman, Okla.: Oklahoma Geological Survey. Paper; 6x9 in.; pp. 22; illustrated.

SECTIONS OF THE SYDNEY COAL FIELDS, CAPE BRETON, NOVA SCOTIA—By Joseph G. S. Hudson. Ottawa, Canada: Department of Mines. Paper; 6x9 in.; pp. 6; illustrated.

SIMPLIFIED FORMULAS AND TABLES for Floors, Joists and Beams; Roofs, Rafters and Purlins—By N. Clifford Ricker, Professor of Architecture, University of Illinois. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. vi + 77; 16 text figures. $1.50, net.

STANDARD SPECIFICATIONS FOR HYDRANTS AND VALVES—Adopted by American Water Works Association, June 24, 1913. Troy, N. Y.: Secretary, J. M. Diven, 47 State St. Paper; 6x9 in.; pp. 15.

These Specifications were printed practically in full in our issue of Aug. 7, 1913.

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN—Compiled by Chas. E. Ferris, Professor of Mechanical Engineering, University of Tennessee. Eighteenth edition. Knoxville, Tenn.: University of Tennessee. Leather; 3x6 in.; pp. 244. 50c.

In addition to the various engineering tables, this revised edition contains new matter on first-aid in case of electric shock, shop injuries, poisoning, etc.

TELEPHONE CABLES—A Handbook of the Design, Construction and Maintenance of the Telephone Cable Plant. By J. C. Slippy. Pittsburgh, Penn.: The Author, 428 Oliver Bldg. Cloth; 4x7 in.; pp. xviii + 147; 97 text illustrations. $2.50, net.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Vol. 5, 1912. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. iv + 284; illustrated; $6, net.

TREATING RAILWAY TIES (Parts IV, V and VI).—By W. F. Goltra. Cleveland, Ohio: The Author. Paper; 6x9 in.; pp. 87; 2 folding plates.

This pamphlet is a continuation of a compilation of papers and discussions on the subject, giving the author's views and opinions. It includes (1) a paper (by H. Weiss) on a comparison of zinc-chloride and creosote as preservatives, (2) a history of wood preservation, and (3) a list of timber-treating plants in North America.